Vol. 91, No. 14 New York, April 7, 1928 *Pages 693-744*

L. W. W. MORROW Managing Editor
EARL WHITEHORNE Commercial Editor
ALLEN M. PERRY Associate Editor
G. F. WITTIG Statistical Editor
H. M. CAMERON Financial Editor
F. C. WELLS News Editor
EUSTACE C. SOARES Manufacturing and Markets Editor

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

W. H. ONKEN, JR., *Editor*

FRANK R. INNES and T. P. KINDIG Western Editors 7 South Dearborn St., Chicago
H. S. KNOWLTON New England Editor 88 Tremont St., Boston
WALTER C. HESTON Pacific Coast Editor 883 Mission St., San Francisco
E. R. SHARLES Assistant Editor
PAUL WOOTON Washington Correspondent National Press Bldg., Washington

Contents of This Issue

EDITORIALS 693
Why Should Municipal Plants Be Exempt from Supervision? 693
"Legalizing" Preferreds and Debentures 693
Blame for Cable Failures 694
Sanity in Station Design 694
Electric Homes for Egyptian Ones 695
Effect of the New Radio Law 695
Conductor Movements Influence Line Design 695

Frontispiece—SHORT-WAVE POWER TRANSMISSION 696

LOADED HIGH-VOLTAGE CABLES 697
By A. F. Puchstein
Calculations on 132,000-volt cable for long-distance transmission. Shunt vs. series loading considered and method of calculation outlined.

THREE-CIRCUIT AMMETER SWITCH 699
By James C. Jackson

CABLES RACKED ON IRON-PIPE SUPPORTS 700
By T. W. Swartz

VOID FORMATION IN CABLES 701
By W. N. Eddy
Quality of insulation apparently not limited by present materials. Relations between contraction, viscosity and compound temperature.

TIME-DELAY UNDERVOLTAGE DEVICE MINIMIZES INTERRUPTIONS 706
By L. C. Hardesty

CABLE SHEATH TROUBLES AT DUCT EDGES 706
By C. H. Shaw

ELECTRIC WELDING CUTS STEEL BRIDGE TONNAGE ONE-THIRD 707

CONOWINGO NOW OPERATING 708

POINTERS FROM ALEX DOW 710
Points made in address before Midwest Power Conference in Chicago hit at misconceptions as to utility affairs. Costs of business and business policy outlined.

SERIES CIRCUIT WITH OUTDOOR TRANSFORMERS AND SWITCHES 711

SIGN EXHIBIT CREATES SALES 711
By R. B. Brown, Jr.

A FLEXIBLE COMMERCIAL DEPARTMENT ORGANIZATION 712

ELECTRIC HEAT IN INDUSTRY 712

CONTROL OF BOILER AUXILIARIES 713
By W. S. Martyn
Nature of operations that had to be controlled in running powdered-coal-fired, water-walled, well-type furnaces at Buffalo and type of signaling and interlocking adopted.

FINDS EXHAUST GASES IMPRACTICABLE FOR HEATING 716
By H. C. Thuerk

APARTMENT BUILDING FLOODLIGHTED DURING CONSTRUCTION 716

TREND IN PRICES OF SUPPLIES 717
Prices virtually down to a pre-war basis. Items listed make up 60 per cent of average jobber's total sales.

TEN MONTHS' SALE OF ELECTRICAL FARM EQUIPMENT 719

LETTERS FROM OUR READERS 720

DIGEST OF ELECTRICAL LITERATURE 721

NEWS OF THE INDUSTRY 723
COURT DECISIONS, COMMISSION RULINGS 730
MEN OF THE INDUSTRY 731
FINANCIAL AND STATISTICAL 733
BUSINESS NEWS AND MARKET CONDITIONS 737
NEW EQUIPMENT AVAILABLE 741
ELECTRICAL PATENTS 742

BUSINESS FACTS FOR ELECTRICAL MEN 743

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., NEW YORK, N. Y.

JAMES H. McGRAW, President
JAMES H. McGRAW, Jr., Vice-Pres. and Treas.
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

NEW YORK District Office, 285 Madison Ave.
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn St.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London E. C. 4

Cable Address "Machinist, N. Y."

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Electrical Merchandising
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Construction Methods
Electrical World — Radio Retailing
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.
Circulation of this issue 19,450

The annual subscription rate is $5 in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Haiti and Paraguay. Extra postage to other countries $4 (total $9 or 38 shillings). Subscriptions may be sent to the New York office or to the London office. Single copies, postage prepaid to any part of the world, 25 cents.
Change of Address—When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before the change takes place.

Copyright, 1928, by McGraw-Hill Publishing Company, Inc.

Published weekly

Entered as second-class matter Jan. 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.

Advertising Index—Alphabetical, 130; Classified, 124, 126, 128; Directory of Engineers, 64, 65; Searchlight Section, 66-71

OKONITE QUALITY

A Standard Rigidly Maintained for Fifty Years

It is impossible to make the finest grade of rubber insulated wire and cable without:

1. The finest *quality* of crude rubber— the kind which naturally possesses greatest durability and toughness.
2. Combining this crude rubber in sufficient *quantity* with other carefully selected ingredients to obtain an insulating compound of desired long life and high electrical qualities.
3. *Application* of this compound by a method which assures perfect centering of the conductor and provides a wall of equal thickness all around.
4. Vulcanization of the compound by a method which prevents swelling of the rubber and provides a dense, homogeneous, non-porous insulation.

Quality

Nothing but wild Up-River fine Para Rubber is used in making Okonite Insulation. It is tougher and more lasting than any other form of rubber which could possibly be used.

Quantity

This rubber is combined with ingredients of such small bulk and high density that the rubber constitutes 30% of the compound by weight and 60% by volume— a quantity assuring longest life and highest insulating qualities.

Application

The compound, backed by tin, is *folded* around the conductor— an *exclusive* Okonite process which assures perfect centering of the conductor and an insulating wall of equal thickness all around.

Vulcanization

The tin backing forms a rigid mould which prevents the rubber from swelling during vulcanization. This is another exclusive process which provides greater density, longer life, greater tensile strength and improved electrical qualities.

THE OKONITE COMPANY

THE OKONITE-CALLENDER CABLE COMPANY, INC.

FACTORIES: PASSAIC, N. J. PATERSON, N. J.

SALES OFFICES: NEW YORK . CHICAGO . PITTSBURGH . ST. LOUIS . ATLANTA
BIRMINGHAM . SAN FRANCISCO . LOS ANGELES . SEATTLE

General Electric Supply Corporation, Boston, Mass.
Novelty Electric Co., Philadelphia, Pa. F. D. Lawrence Electric Co., Cincinnati, O.

Canadian Representatives: Engineering Materials, Limited, Montreal

Cuban Representatives: Victor G. Mendoza Co., Havana

Electrical World

Published by McGraw-Hill Publishing Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 91 — *New York, Saturday, April 7, 1928* — NUMBER 14

Why Should Municipal Plants Be Exempt from Supervision?

WHAT is there so sacrosanct about the business of government, and especially municipal government, that its exponents are moved to insist that government shall be a law unto itself and that it shall not be subject to constant scrutiny and examination? Government is the greatest business in the country, and yet in most instances it is the most poorly conducted. Whence, then, the cry "Touch not mine anointed"? Regulation and supervision are exercised over all public utility corporations except the vast majority of those municipally owned and operated. To the latter are granted indulgences, so to speak, and they receive preference over utilities otherwise owned. Why? Surely not because they give a better service or because their affairs are managed with more scrupulous regard for the rights of the public. On the contrary, they are, if anything, more remiss than ordinary corporations in rendering an account of their stewardship to their stockholders—that is, to the public. Men who are elected or appointed to public office seem to forget that they are servants, not masters, and that powers of office are a public trust.

Consider the catastrophe which overtook the inhabitants in the San Francisquito Valley of California recently by the failure of the St. Francis Dam. Hundreds of lives were lost because of the derelictions of municipal engineers whose work was not subject to state supervision. When a few years ago some dams failed in San Diego County the Legislature of California passed a law requiring supervision and inspection of dams by the State Engineer. When the measure was first introduced it provided for supervision of all dams, but a proviso was later slipped in at the instigation of lobbyists (mark the word and by whom they were employed) exempting municipalities having their own engineering departments. When a public utility company erects a dam in California the work is subject to the approval and continuous inspection of the State Engineer and also of the Public Service Commission. The dam erected by the Los Angeles municipal Water and Power Department was never inspected by any one but itself.

This incident also brings up some question regarding the Boulder Canyon Dam on the Colorado River. There are engineers who feel that the Boulder Canyon project has not received careful scrutiny from engineers not interested directly in it. There are others who, in the light of the St. Francis Dam failure, point to the enormous hazards involved in holding back such an immense quantity of water by a single dam of huge proportions. Before the government spends hundreds of millions at Boulder Canyon would it not be well to give further thought to the entire matter—first, to determine whether the engineering plans and the location are all that is claimed and, second, to ascertain whether it might not be better to impound the water of the Colorado in a number of smaller dams, one of which could be built near Needles for immediate protection and the others erected farther upstream than Black Canyon? Certainly, the experience in the San Francisquito Valley should cause very serious inquiry and thought to be given to the Boulder Canyon project, which will impound 720 times as much water as was unloosed by the failure of the St. Francis Dam.

* * * *

"Legalizing" Preferreds and Debentures

UTILITY preferred stocks, notes and debentures are commencing to enter the door of the "legals" in New York State by the terms of the Wales law, passed by the Legislature in its closing days. This law is but another step taken in recognition of the necessity of widening the field of available investment of funds by regulated institutional investors. By its terms life insurance companies — long restricted to real estate mortgages, corporation mortgage bonds and various government obligations—may now invest in the preferred and guaranteed stocks and in the notes of corporations whose earning history is satisfactory as defined by the law.

While they are not referred to specifically, an examination of the securities coming within the provisions of the law discloses that many preferred stocks and debentures of electric light and power companies—both holding and operating—are thus "legalized." To those who are observant this is as it should be. For the untarnished record of preferred stocks in this industry, as well as the even stronger position of the debentures, has long recommended these securities to the discriminating institutional investor who was free to purchase them. Note, for example, the investment list of the Sun Life Assurance Company of Canada as mentioned in these columns last week. This company is well known in the United States for its careful study and keen judgment in investing its funds, and its list shows large amounts of American utility debentures, preferred stocks and even common stocks.

As in the case of legalizing bonds for savings banks and trust funds, so this move has an effect on the yield rate at which securities affected by it may be issued. The total volume of money released to flow into these channels is not very large, comparatively, but the effect of the law was immediately felt in Wall Street. At least one issue then in negotiation between company and banker was increased in price to take advantage of the new tone of the debenture and preferred market which resulted from the law's passage.

From the standpoint of the insured, laws like this will allow insurance companies to invest in securities of higher yield and thus keep down the rates for insurance. From the standpoint of the companies whose security

prices are affected by this increased demand from the insurance companies, the new law indirectly makes it possible to obtain funds from unsecured obligations and preferred stocks at lower yield. But it must be remembered that the primary object of the law was the one stated first, and that certain utilities may benefit in the second way is due to the fact of their past record of performance having placed their securities in a preferred class, now officially labeled "safe." It is a record which deserves to be, and doubtless will be, maintained and zealously defended, and all companies will have this additional inducement to shape their financial structures and formulate their financial policies along lines that will enable them to qualify their securities among the "legals."

* * * *

Blame for Cable Failures

WHO is to blame? This is often a difficult question to answer, resulting in sharp differences of opinion even in the accidents of ordinary life. When it is a case of electrical trouble or failure, the answer is particularly difficult because so often the results of such failure destroy the evidence. A striking instance is the failure of a high-voltage underground cable, a most serious form of trouble, the means of preventing which is the constant study of manufacturers and operating engineers. When the cause of this type of failure is sought there is little use in examining the cable. The blow-out usually destroys the path over which it starts, and deductions in explanation are subject to great uncertainty.

To the discussion of the cause of cable failure there are two principal parties—the operating company and the manufacturer. Each would like to think the other to blame. The search for evidence is largely controlled by the operator. He is immediately on the job and has available the operating history immediately preceding the accident. The manufacturer, if he comes in at all at this stage, hears about it some time afterward, and he must content himself with such information as the operator gives him. He can ask the conditions of operation, and it is, of course, recognized that disturbances of other character in the operation of a large system may lead to the failure of cables which would probably show normal life under normal conditions of operation. This is the refuge of the manufacturer in the face of the accusing finger of the operator.

There is another important factor in this question. The operating companies are organized in several well-known national associations. The manufacturers, however, owing to their competitive relationship, have no such common ground on which they can seek measures of mutual protection against the frequent claim of the operating companies that cable failures are largely due to defects of manufacture. The National Electric Light Association has published through a number of years the records of cable failures in which some attempt is made to segregate these failures as due to cable defects or to operating conditions. In addition, similar data are given as to joint failures. Some of these reports are accompanied by quite definite suggestion that many of the cable failures are to be laid at the door of the manufacturer. The manufacturer replies: "Some perhaps, but not so many as you think."

A close study of the N.E.L.A reports for the years 1923-1926 seems to yield somewhat more light on these differences than appears on the surface. For example, of the total cable failures reported, those due to injuries under service conditions are double in number those classified by operating companies as due to defective cables. There is at least some likelihood that many failures ascribed to deterioration, defective workmanship and "X" wax are in reality due to manufacturing defects; if this were so, the number of these failures should be practically independent of the particular operating company on whose system the cable operates. From the data this is by no means so, and in fact it may be seen that if a company has a great number of total failures or a great many operating failures, this condition is accompanied in almost all cases by a large number of cable failures. It is also possible to correlate the reports on joint failures in such a way as to indicate that a portion of the defects attributed to manufacture in all probability are the results of joint failures. From which it might be argued with some force by the manufacturer that attention to general operating conditions and to general methods of installation in the direction of improvement would probably also result in a reduction of failures classified as due to manufacture.

* * * *

Sanity in Station Design

IT IS well to appraise values in power-station design at frequent intervals. The time is ripe for a study of dollar economy based on the costs and performances of new stations that embody departures from past practices and that differ one from another in many features. Total energy cost at the switchboard, and not thermal economy, is the ultimate gage of merit. Complexity, automatic equipment, large units, reserve lines of defense, purpose of station, labor cost and many other items offer themselves for study. Automatic equipment is justified only as it reduces labor costs and improves performance—it is expensive, adds to the complication of the plant, requires high-grade maintenance men and must justify its use on an economic basis. The craze for high thermal economy leads to the use of high pressures, high temperatures, two fluids, reheating, preheated air, special furnaces and other things which are good only as their use reduces the total cost of generating energy during the normal life of the station. Fuel is too cheap to permit of glorified design at the expense of station costs.

Then on the electrical side there is a large amount of money spent for double buses and breakers, protective devices, reserve auxiliary and excitation supplies, switch houses and other items which may or may not be justified for each power station. No property can use a standard station design without spending money to excess, but, on the other hand, no property can without losing money make individual station designs as regards details of equipment which depart from standard.

Simplicity, reliability, minimum labor in cost and volume, lowest over-all cost of energy, suitability for service conditions and ease in operation and maintenance are the important factors in power stations. With many now in operation that have a 100 per cent cost variation per unit of capacity and with every conceivable type and arrangement of equipment installed, it would be well worth while to appraise the operating plants so that new designs could benefit. Any defensive position which might be taken by plant engineers to cover errors and inconsistencies must give way to a constructive attempt to make new stations better and cheaper through the use of the experience available. Past mistakes are forgivable, but they should not be repeated.

Electric Homes for Egyptian Ones

IN ANCIENT times men built homes of wood, brick and stone by hand labor and with crude methods of construction. Even today our homes are the crudest and least efficient assemblies of these ancient materials and afford a sad commentary on the lack of initiative among modern builders and home owners. Home building follows Egyptian practices despite the advent of iron and cement and the development of skyscraper architecture. For housebuilding purposes metal pieces welded together, with fireproof fillers for walls and partitions, offer a means to get comfort and beauty at low cost. Fireproof structures of infinite variety can be built of modern materials in the modern way, and the current attempts to introduce these ideas to home owners should be encouraged by the electrical industry.

A steel-frame house with a solidly grounded neutral of bare metal offers attractive possibilities for reducing wiring costs. Methods of wiring and of installing illumination could utilize the advantages that pertain to a grounded structure. Whether heated by electricity or fuel, this type of home could have insulated walls and partitions that would save heat energy in cold weather, and in warm weather air refrigeration would be placed within the bounds of possibility. With the insulated, ventilated and flexible home possible by the employment of modern materials and construction practices there is no valid reason why the American home should remain either a square wooden box, a stone pile or a mound of unsightly bricks. Fondness for the antique can be carried to extremes.

* * * *

Effect of the New Radio Law

CONGRESS has passed the radio bill. The President has signed it. It is the law. The electrical industry is wondering just what it means. The electrical industry is interested because radio is fast becoming an energy-consuming appliance important to the power companies, because many electrical manufacturers are making radio parts or sets, because electrical jobbers and dealers are selling radio merchandise, and because electrical contractors are installing radio wiring. Electrical men, therefore, have a valuable stake in the prosperity of the radio industry and are concerned over what the effect of the new law may be.

In a word, the life of the Federal Radio Commission has been extended one year, but there has been imposed upon the commissioners an amendment that demands that each zone shall have an equal number of stations, an equal amount of power and an equal number of wave channels and that within zones these shall be allocated according to the population of the states within the zone. From the technical standpoint it is a difficult situation. No one would think of demanding that there be an equal mileage of railroads in every zone, or an equal production of electric power, or an equal number of telephones. No one would ask that there be an equal number of letter carriers. This is now required of radio, however, despite the obvious fact that broadcasting studios must naturally be located where artists are available and that therefore the great studios of New York and Chicago are providing programs of a quality that cannot be achieved in smaller communities.

But, on the other hand, it is also a fact that New York or Chicago stations, even with superpower, cannot carry into distant Southern and Western states. It is for this reason that the networks have been organized. It is also true that these networks are not yet extensive enough to enable the entire United States to enjoy the advantage of the big-city programs. It is this condition that the new legislation proposes to overcome. What will be the effect of this law? The commission is now endeavoring to solve the intricate problems of its application.

It may influence the expansion of chain broadcasting from the big studios by wire to more new and modern stations that eventually will cover the entire country. It may lead to the organizing of more good studios in smaller cities across the map. In any event, the program should provide for the continuing development of high-powered broadcasting that guarantees good service in warm weather. For, after all, what the public wants and what the electrical industry wants is just good reception of the best possible programs available in every home—at all seasons, no matter where. This should be the aim.

* * * *

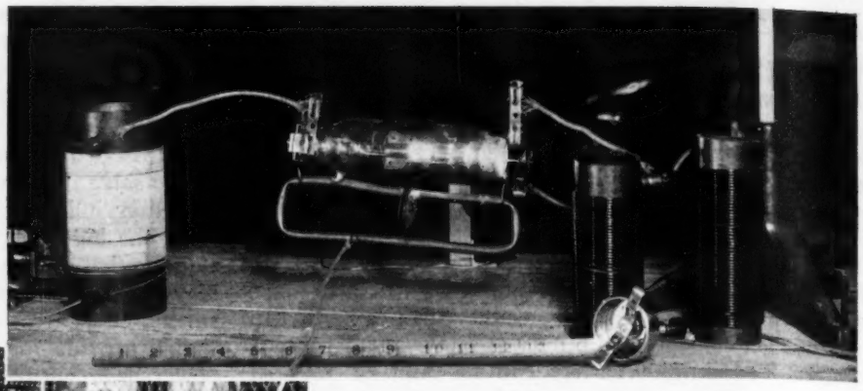
Conductor Movements Influence Line Design

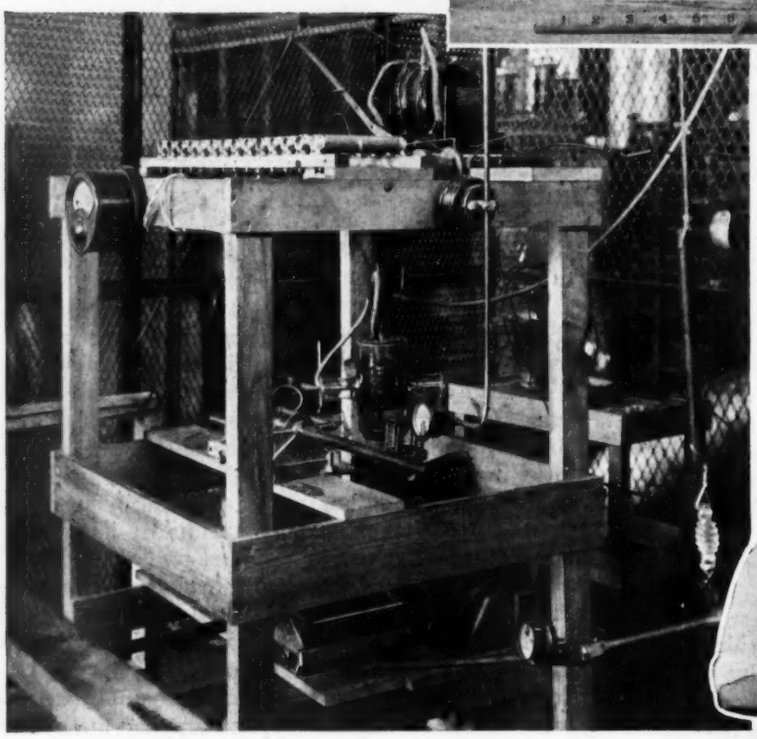
TESTS conducted by the Bureau of Power and Light of Los Angeles to determine movements of overhead conductors under short-circuit conditions revealed conductor movements which indicate that short-circuit forces are a factor that must be taken into consideration in overhead-line design. Virtually no information was available on the subject when the bureau undertook its investigation, and the results of its tests should prove of great value to the industry.

Efforts to calculate conductor movements proved unsatisfactory, and full-scale tests had to be resorted to. Tests were made at night when sufficient generator and transformer capacity was available to supply the high short-circuit currents necessary. Conductor movements were measured by an ingenious photographic method which gave a graph of the actual path followed by the conductors. On a 150-ft. span with No. 4/0 conductor, spaced 4 feet and strung under a tension of 10,400 pounds, the maximum throw of the conductors from their original position was 4.07 feet with a short-circuit current of 12,700 amperes maintained for 1.05 seconds. Numerous other tests were made, but this one example serves to indicate the very violent movement of conductors to be expected under what may be called normal conditions obtaining on a 2,400-volt distribution circuit within a few blocks of a substation.

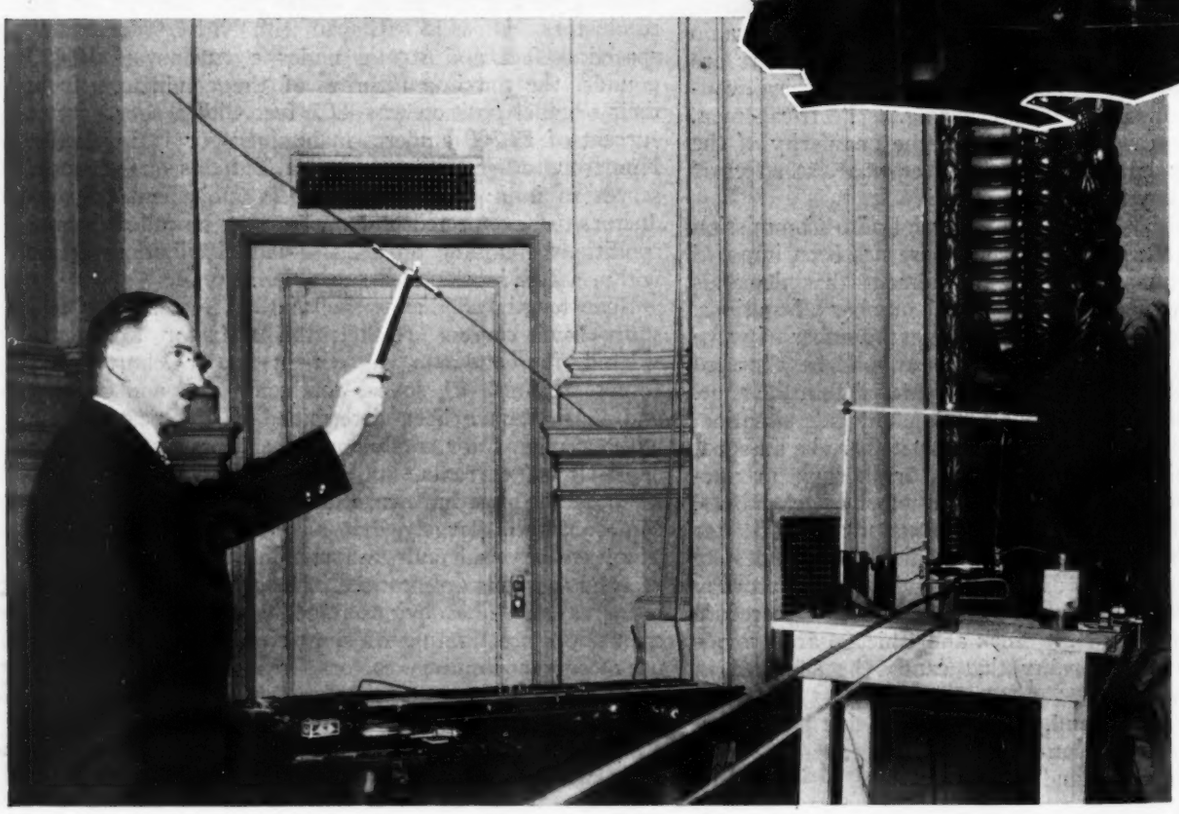
Span length, conductor size and spacing, tension and short-circuit current are the principal factors to be considered in conductor movement under short-circuit forces. Length of spans, conductor size and spacing and tension have been determined in the past largely without regard for conductor movements due to heavy short-circuit currents, but it is now evident that this latter factor must have careful consideration also. Load conditions will largely determine conductor size, and there are physical and economic limits which are soon reached as spans are reduced in length and wire spacing is increased. The obvious remedies, then, that suggest themselves are limiting of short-circuit currents by the use of current-limiting reactors, breaking systems up into smaller loosely coupled units, underground distribution, and some mechanical means of preventing conductors from being violently repelled and coming together on the back switch.

Short-Wave Power Transmission





HIGH-FREQUENCY, vacuum-tube oscillators of the designs illustrated have recently been developed in the laboratories of two American manufacturers. Standard filament lamps and neon-filled tubes may be lighted through contact with isolated conductors of such length as to offer resonant response to the transmitted waves. Food may be brought to a "cooked" condition in exceedingly brief time and the temperature of the human body raised without external heat.



Loaded High-Voltage Cables

Calculations on 132,000-volt cable for long-distance transmission. Shunt vs. series loading considered and method of calculation outlined

By A. F. PUCHSTEIN

Assistant Professor of Electrical Engineering, Ohio State University

THE recent installation of two 132,000-volt cables, which was announced in the ELECTRICAL WORLD for Sept. 3, raises some interesting questions as to what may be expected from such circuits when used for longer distances. At present the circumstances necessary to make such an installation economically feasible do not exist. It is believed, however, that a review of some of the problems met with and the possibilities of loading will be of interest.

Information previously published indicates that these cables have an insulation thickness of $\frac{3}{4}\frac{3}{2}$ in. The conductors are hollow with an area of 600,000 circ.mil. The external diameter is 3.1 in. The rating is about 90,000 kva. at a carrying capacity of about 300 amp. The resistance of a conductor is about 0.095 ohm and the capacitance 0.366 mfd., both per mile. The cable requires a charging current of 10.5 amp., or 2,400 kva. per mile at 60 cycles.

Obviously, this cable cannot be used for distances greater than roughly 30 miles, because the charging current would then exceed the carrying capacity. What, then, would happen in the case of distances of, say, 100 or 200 miles? Even if the cost can be reduced sufficiently, it will not be possible to use cable under this condition, unless a way can be found to reduce the capacitance or unless some form of compensation is employed. There is not much hope of reducing the former, hence recourse must be had to the latter. Compensation would be desirable even if the inductivity of the insulation used could be reduced to unity.

For this purpose the use of shunted reactors connected at intervals across the line is most suitable for all distances. The idea was proposed by Bradley for use with overhead lines about 29 years ago and S. P. Thompson for telephone circuits about 33 years ago. Such inductances serve to neutralize the effects of line capacities. The action is best if the coils are not too far apart. Spacings of the order of 25 miles would be suitable. Bradley's scheme was never used because the low capacitance of overhead lines made it unnecessary. The Thompson idea was never used in communication work because series loading gives more nearly equal attenuations at the different frequencies. Shunt loading is not affected by voltage variations.

In power cables we are concerned with only a single frequency and the defects of shunt loading do not trouble, whereas its advantages make it a possibility. The growing use of power cables seems destined to revive this type of loading. No coils suitable for this purpose have been developed, but no difficulty is expected. Such a coil would be similar to a high-tension transformer with a core specially designed to require a large magnetizing current and the secondary winding omitted. This would be accomplished by using a core material of higher reluctance than customary or by including an air gap in the magnetic circuit.

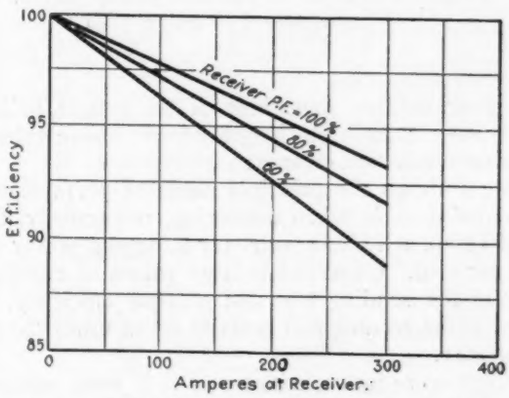


Fig. 1—Efficiency of 200-mile, three-phase, 132,000-volt, 600,000-circ.mil cable devoid of capacitance and leakance

An alternative arrangement would be to use step-down transformers to feed reactors or synchronous motors, but either of these would be less efficient and more expensive. The delivered voltage can be regulated by synchronous motors in the usual way, keeping in mind the lower reactance of cables as compared with overhead lines. When necessary for purposes of regulation enough series reactance may be added artificially.

TABLE I—CALCULATED PERFORMANCE OF A 200-MILE, THREE-PHASE, 132,000-VOLT, 600,000-CIRC.MIL CABLE

Receive current in amperes	0	120|36°50′	240|36°50′
Current at generator end in amperes	2,090|94°41′	2,030|91°30′	1,990|88°30
Voltage to neutral at generator end	78,200|14°30′	78,800|13°30′	82,000|12° 0
Kva. per conductor at generator end	164,000	160,000	163,000
Kva. per conductor at receiver end	0	9,400	18,800
Kw. per conductor at generator end	27,900	33,100	39,800
Kw. per conductor at receiver end	0	7,510	15,000
Efficiency in per cent	0	25.8	37.8
Regulation in per cent	0	0.8	5.0

TABLE II—APPROXIMATE PERFORMANCE OF A SHUNT-LOADED, 200-MILE, THREE-PHASE, 132,000-VOLT, 600,000-CIRC.MIL CABLE

Receiver current	0	120			240		
Receiver power factor	.....	0.6	0.8	1.0	0.6	0.8	1.0
Kw. per phase at receiver	0	5,640	7,510	9,400	11,300	15,000	18,800
Reactive kva. per phase at receiver	0	7,510	5,640	0	15,000	11,300	0
Approx. line input, kw	4,900	10,800	12,700	14,600	17,300	21,000	24,800
Approx. line input, kva	4,900	13,200	14,200	14,600	22,900	23,900	24,800
Approx. efficiency, per cent	0	52.1	59.1	64.5	65.2	71.5	75.8
Approx. regulation, per cent	0	1.8	2.3	3.0	3.7	4.9	6.0

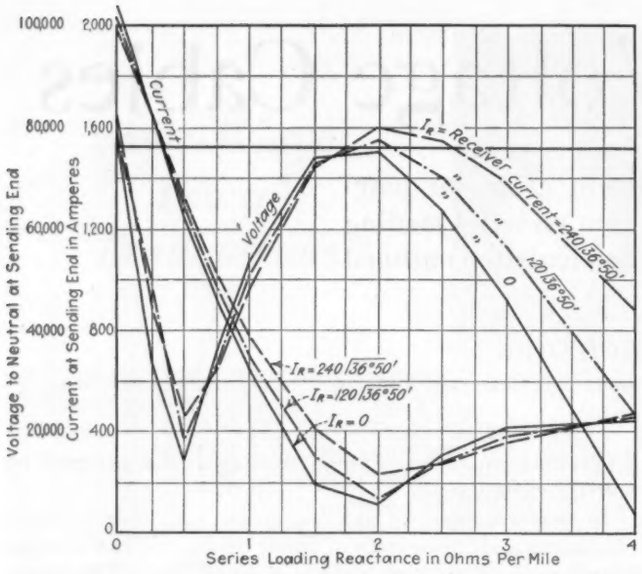


Fig. 2—Calculated performance of 600,000-circ.mil series loaded power cable for different receiver loads at 132,000 volts and 80 per cent power factor. Distance 200 miles

In order to give some idea of the results to be expected from a 200-mile length of the above cable, the following results are offered:

Table I shows the principal items of performance of the unloaded cable when delivering, respectively, 0, 120 and 240 amp. at 132,000 volts for a lagging power factor of 80 per cent. Observe the large values of current and power at the sending end and the low efficiency. The current at the sending end is about seven times the carrying capacity.

If there were no capacitance or if it were neutralized without loss so that the cable would behave as an ordinary "short" line, the efficiency under different conditions would be as shown in Fig. 1. This represents the ideal that would be attained if the application could be made without introducing new losses.

When shunt loading is applied, the coils take the place of the larger part of the generating capacity that would be required for the plain cable, with the added advantage that they supply the charging current at points along the line where it is needed. This current does not then need to travel over the line. When considered in the same way as transformers, the total rating of coils needed per conductor would be about $13{,}200 \div \sqrt{3} \times 2{,}090 = 159{,}000$ kva. The losses in such coils would not be as great as in the corresponding transformers, because there is no secondary winding. A 3 per cent loss based on

TABLE III—CONSTANTS OF THREE-PHASE, 132,000-VOLT, 600,000-CIRC.MIL SERIES LOADED POWER CABLE

Reactance Per Conductor, Ohms Per Mile	Attenuation Constant	Wave-Length, Constant	Propagation Velocity, Miles Per Second	Wave-Length, Miles	Surge Impedance, Ohms
0.00	0.00256	0.00256	147,000	2,450	2.62|45°
0.25	0.00115	0.00595	63,900	1,065	44.0 | 10°25'
0.50	0.000785	0.00834	45,100	752	60.7 | 5°23'
0.75	0.000644	0.0102	37,000	616	73.9 | 3°37'
1.00	0.000556	0.0117	32,200	536	85.2 | 2°43'
1.50	0.000458	0.0144	26,100	435	105.0 | 1°49'
2.00	0.000348	0.0166	22,700	378	120.0 | 1°22'
2.50	0.000332	0.0186	20,300	338	135.0 | 1° 5'
3.00	0.000322	0.0204	18,500	308	148.0 | 0°55'
4.00	0.000280	0.0235	16,000	267	170.0 | 0°41'

the kilovolt-ampere rating, or 4,900 kw., would be a conservative figure. The exact total loss between generator and receiver may be found from the longer lines theory. For the present purpose it is sufficient to take

$$\text{Line Input} = \frac{\text{Line Output}}{\text{Efficiency From Fig. 1}} + \text{Total Coil Loss}$$

The values so obtained will not differ seriously from the correct figures. The results when using this approximate calculation are as given in Table II. The kilovolt-amperes at the generator end were taken as the quad-

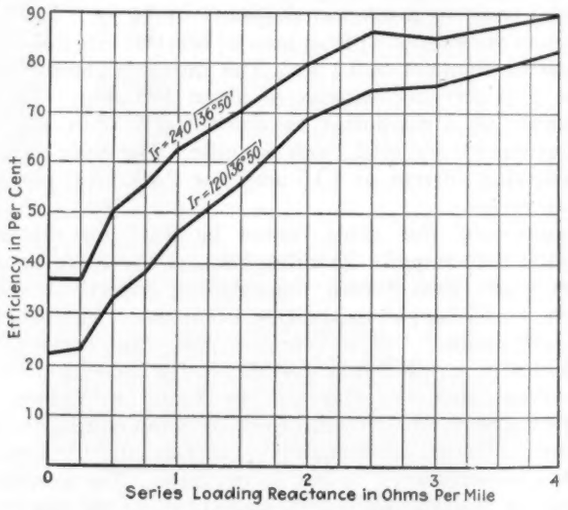


Fig. 3—Calculated efficiency of 132,000-volt series-loaded power cable

rature sum of the reactive kilovolt-amperes at the receiver end and the sum of the kilowatts necessary to cover the receiver load, line copper loss due to receiver load current, and coil losses. This neglects the line copper losses due to the coil loss current, although in this example they would be appreciable. The efficiency is

TABLE IV—CALCULATED PERFORMANCE OF 600,000-CIRC.MIL SERIES-LOADED POWER CABLE FOR DIFFERENT RECEIVER LOADS AT $\frac{132{,}000}{1\sqrt{3}} = 76{,}200$ VOLTS AND 80 PER CENT POWER FACTOR. DISTANCE 200 MILES

Loading Reactance in Ohms Per Mile	Receiver Current = 0 Amp.				Receiver Current = 120/36°50' Amp.					Receiver Current = 240/36°50' Amp.				
	Sending Voltage	Sending Current	Sending Kva.	Sending Kw.	Sending Voltage	Sending Current	Sending Kva.	Sending Kw.	Efficiency	Sending Voltage	Sending Current	Sending Kva.	Sending Kw.	Efficiency
0	78,200	2,090	164,000	27,900	78,800	2,030	160,000	33,100	22.1	82,000	1,990	163,000	39,800	37.8
0.25	33,500	1,660	55,600	22,500	48,800	1,660	73,400	31,600	23.2	44,200	1,670	81,500	40,000	36.6
0.50	13,700	1,260	17,300	15,400	17,200	1,280	22,000	21,900	33.4	22,500	1,308	29,400	28,800	50.8
0.75	35,800	928	33,200	12,100	33,500	975	32,700	19,100	38.2	33,000	1,025	33,800	26,200	55.9
1.0	53,300	648	34,500	9,040	50,300	715	35,000	15,900	46.2	48,300	785	37,900	23,500	62.3
1.5	73,900	200	14,800	5,570	72,800	305	22,200	13,000	56.3	71,900	416	29,900	20,800	70.4
2.0	75,400	120	9,050	3,180	77,500	143	11,100	10,700	68.4	80,000	234	18,700	18,400	79.6
2.5	64,000	310	19,840	2,560	70,500	275	19,400	9,870	74.1	77,500	274	21,200	17,500	86.1
3.0	46,100	414	19,100	2,080	57,000	380	21,700	9,690	75.5	69,000	361	24,900	17,200	85.1
4.0	3,840	448	1,716	1,612	24,000	453	10,870	8,880	82.4	44,300	460	20,400	16,300	89.8

markedly less than for a "short" line, but is roughly double that of the plain cable.

When the capacitance is neutralized, the regulation may be calculated in the same way as for a short line. The actual figure will be modified by the power current necessary to supply the coil losses. This factor was neglected in Table II.

The results show that shunt loading is capable of considerably improving the efficiency. It equalizes the current so that it is brought within the carrying capacity at all points. The generating capacity that would otherwise be necessary to charge the cable is replaced by cheaper apparatus in the form of loading coils. There is practically no Ferranti effect and cables may in this way be used for voltages and distances that would be impracticable otherwise. It is beyond the scope of this article to discuss the relative merits of coils and synchronous motors.

Series Loading for Power Cables

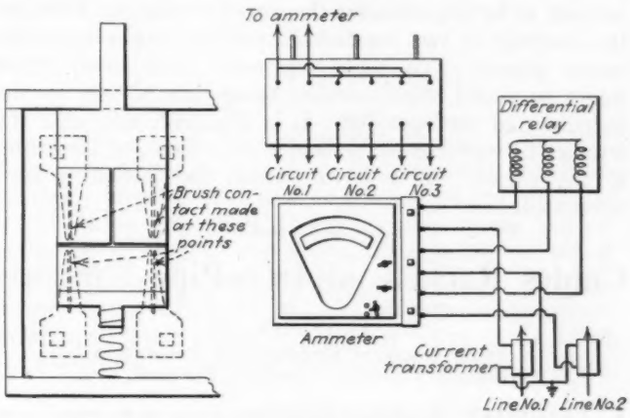
Although this scheme has never been proposed for improving the performance of power cables, it is instructive to compare the results with those previously given. The calculations were made under the assumption that the application introduces no additional losses. The figures represent the highest theoretically attainable values for ideal coils having no copper or core losses. Fig. 3 shows that the efficiency increases markedly with increase in reactance, reaching values above 80 per cent, but this would be considerably reduced if the coil losses were taken into account. The current is not uniform along the line and greatly exceeds the carrying capacity in certain regions. The voltage, also, will not be uniform along the line. These two factors are the fatal objection to this type of loading. It is effective only after the length of line exceeds a certain value, roughly about 100 miles. The total coil rating required is very considerable and is quite comparable with that needed for shunt loading. With nine coils per wave length, which are necessary to approximate a smooth line, the coil spacing would not need to be much less than 25 miles, although when spaced so far apart the coils would have to carry a considerable difference of potential. Fig. 2 shows the relation between sending-end voltage and current for three different receiver loads with different values of loading reactance. Such a cable would be cable of giving a good regulation under certain conditions. The principal constants are given in Table III.

Three-Circuit Ammeter Switch

By James C. Jackson
Detroit Edison Company, Detroit, Mich.

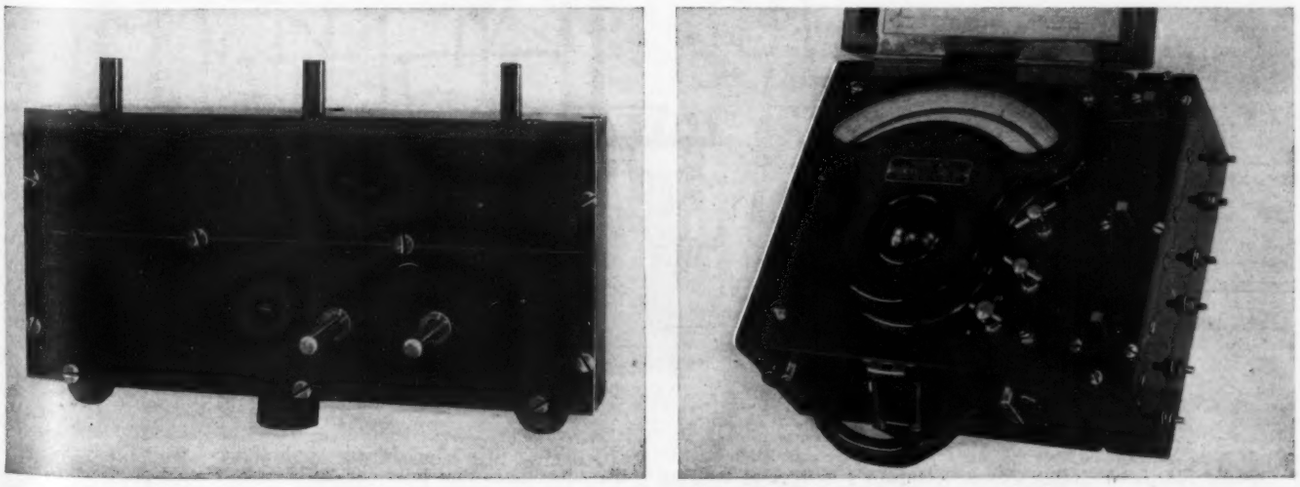
ANY change in routine-test methods or equipment which reduces the number of pieces of apparatus that must be carried is appreciated by the field test man. One ammeter, and in some cases two, is eliminated from certain routine tests on the system of the Detroit Edison Company by the connector switch here described.

This piece of apparatus was designed to enable testers



Design and connections of three-circuit ammeter switch

in the relay division to read the current in any one of the three circuits of a General Electric type PD 3 differential relay on the same ammeter. The device, as shown in the accompanying illustrations, consists merely of three push switches, normally holding the transformer secondaries closed, so designed and connected that the ammeter is cut into any one of three circuits by depressing the proper key. The switches are mounted in a bakelite box as shown. The test circuit for which the device was made is shown in the drawing. Tests are usually made with the lines dead, and currents of 200 to 400 amp., at about seven volts, obtained from a loading transformer are passed in series through the primaries of current transformers on like phases of the two lines. Under this condition there should be equal currents in the holding coils of the relay and no current in the dif-



Three-circuit switch and manner of attachment to ammeter

ferential coil. These three readings are taken on the ammeter by depressing the keys in turn. The device may be connected into the secondary circuits of live lines and used in the same way.

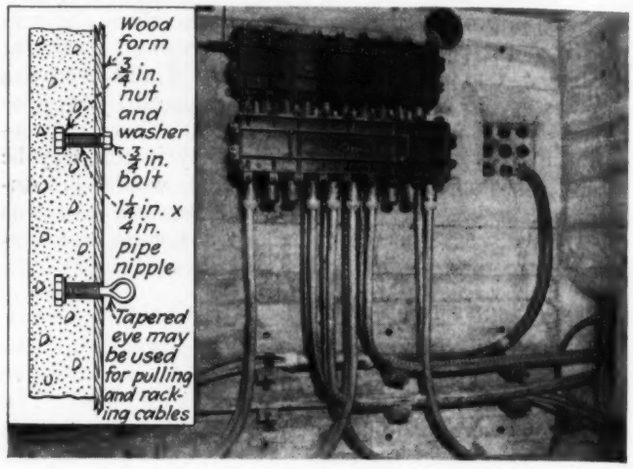
This ammeter switch may be used for many other purposes than that for which it was originally designed. Among these uses are: Taking readings in three phases to determine unbalance; with current transformers on two conductors of a three-phase line to determine the current in the third conductor by depressing two keys together; or, by using a single-phase power-factor meter, the power factor of a balanced three-phase load may be arrived at by determining the angular relations between the currents in two conductors and any one voltage between phases. To these suggested uses many more might be added, their number being limited only by the ingenuity of the operator. It is apparent, also, that the number of switches in the box may be changed according to the variety of uses for which the device is contemplated.

Cables Racked on Iron-Pipe Supports

By T. W. Swartz
Assistant Engineer Underground Department, Northwestern Electric Company, Portland, Ore.

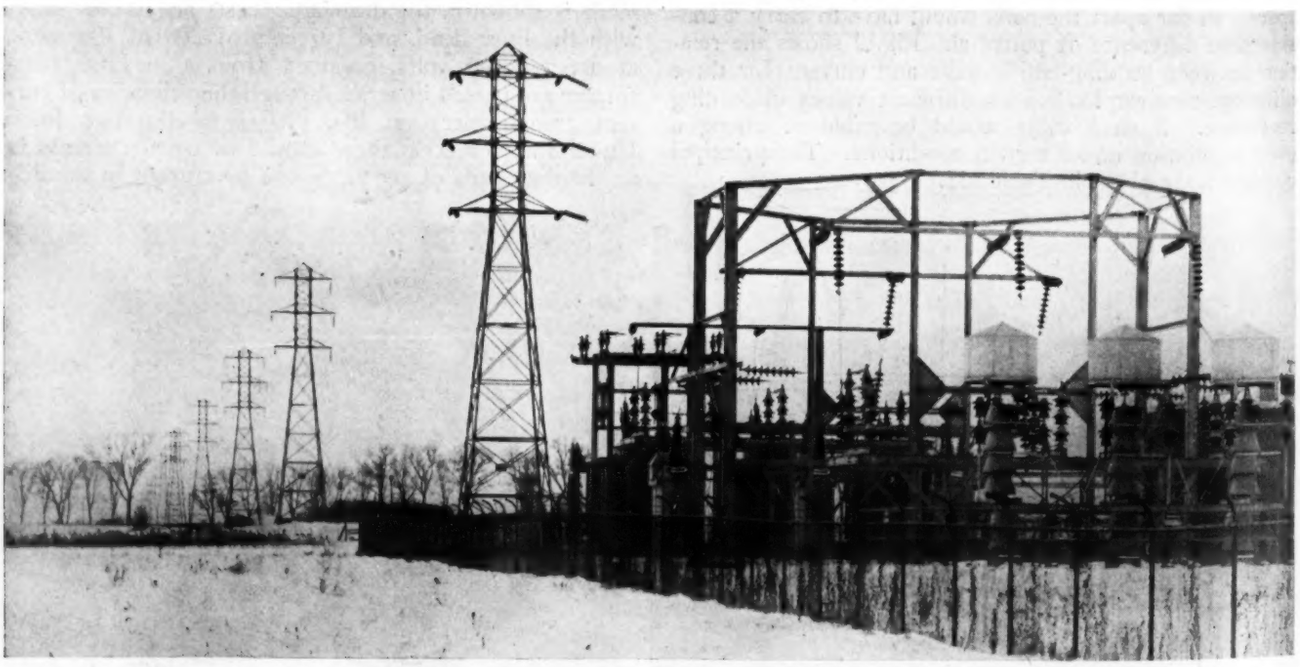
ECONOMY, flexibility and time saved in rigging have led the Northwestern Electric Company, Portland, Ore., to rack cables in vaults as shown in the accompanying illustrations. Black iron pipe nipples 1¼ in. x 4 in. are imbedded in the vault walls at the time the concrete is poured. Into these nipples are inserted 1-in. x 14-in. pieces of pipe for supporting the cables. Grooved wood blocks are slipped over these long nipples to provide a bearing for the lead cables. The imbedded nipples are spaced 8 in. or 10 in. vertically, depending upon the voltage of the cable to be racked. Horizontally they are spaced 2 ft. to 3 ft., depending upon the size and type of cable.

A ¾-in. bolt with nut and washer support the nipples in the form work while concrete is being poured. The bolt later is removed, leaving the nut imbedded in the concrete. A tapered eye threaded for the ¾-in. nut is used to great advantage during pulling and racking cables and for moving heavy equipment about the vault. This feature has saved at least 50 per cent of the time formerly required for setting up to pull cable.



Method of supporting nipples for cable rack while concrete is poured and view of iron pipe hangers placed in imbedded nipples

Octagonal Frame Permits Various Bus Arrangements



On the Northern States Power Company's system as well as other properties of the Byllesby Engineering & Management Corporation may be seen this type of switching structure. It has the advantages that lines can be brought in and dead-ended from any direction and still permits the buses to be run in directions most desirable for the switch and transformer layout.

Void Formation in Cables

Quality of insulation apparently not limited by present materials. Relations between contraction, viscosity and compound temperature

By W. N. Eddy

Director Electrical Research Laboratory
Simplex Wire & Cable Company, Boston, Mass.

CABLE research has established that premature failure of high-voltage cables is usually caused by the presence of voids within the impregnated paper insulation. Under sufficient stress these voids are ionized. Because of the resulting evolution of gas within the voids, the formation and ionization of additional voids may become cumulative, resulting in failure of the insulation. The purpose of this article is to show the influence on the void formation of the viscosity-contraction-temperature characteristics of the impregnating compound and to suggest that the insulation quality of cables for 25- to 75-kv. working pressure can be materially improved by a more general application of these fundamental relations.

Prior to the saturation or original filling of the paper with compound, all moisture has presumably been removed from the paper and its air content reduced to a low value. Complete submersion of the insulation for a suitable time at a suitable temperature in a properly dried and "degassed" compound follows. Economy demands a saturation period as short as may be required to accomplish the purpose. The necessary penetration time depends principally on the compound pressure, the paper "air resistance," compound viscosity and to some extent the nature of the compound. The nature of the paper fiber is practically negligible in its influence as compared with the predominating importance of the air resistance characteristics.

TABLE I—RELATIVE PENETRATION OF DIFFERENT COMPOUNDS AT THE SAME VISCOSITY

All tests at atmospheric pressure five minutes in duration, using 7-mil manila paper, of air resistance = 14 sec./300 cc. Viscosity of each compound at time of test, 66 seconds Saybolt.

Compound	Penetration in Mils	Penetration in Per Cent of Rosin Oil Blend
Blend of rosin and cylinder oil	140	100
Transformer oil No. 1	133	95
Petrolatum No. 3	126	90
Cylinder oil No. 2	119	85
Cylinder oil No. 4	119	85
Petrolatum No. 4	112	80
Cut-back petrolatum No. 1	105	75
Cylinder oil No. 3	98	70
Rosin oil No. 1	98	70

In general, the penetration and viscosity charts and table indicate that the selection of a proper saturating procedure is almost entirely dependent on certain physical characteristics of both paper and compound. No change in any of the related variables should be made without considering the effect on the others.

At atmospheric pressure and room temperature a typical insulating oil can take into solution air equal to about 10 per cent of the oil volume. The solubility of air in such oil increases in direct proportion to the absolute pressure. On this basis, if the oil is properly treated before the saturation, its air content should be below 0.3 per cent at the beginning of saturation. In like manner, the residual air in the insulation at the start should not exceed 2 per cent of the space to be filled with compound. Therefore, if no air is admitted during

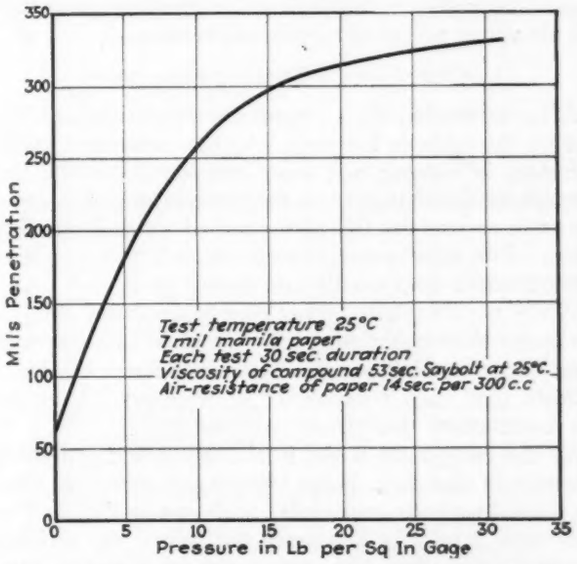

Mils Penetration
Pressure in Lb per Sq In Gage
Test temperature 25°C
7 mil manila paper
Each test 30 sec. duration
Viscosity of compound 53 sec. Saybolt at 25°C.
Air-resistance of paper 14 sec. per 300 c.c

Fig. 1—Effect of pressure on compound penetration

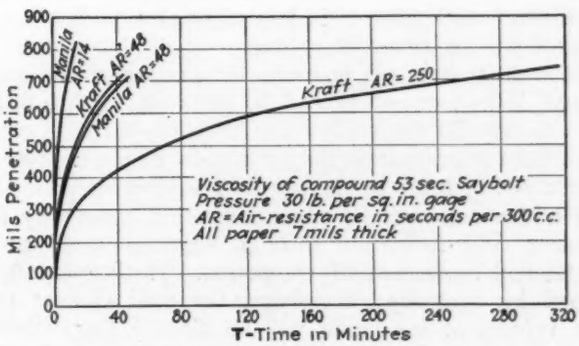


Fig. 2—Compound penetration through wood pulp and manila papers

At 600 mils the penetration through the wood pulp is 4,300 per cent slower than with manila. The two middle curves indicate that the difference between the other curves is due to air resistance rather than to type of fiber. All the penetration-time curves are approximately parabolic with an exponent of about 0.26.

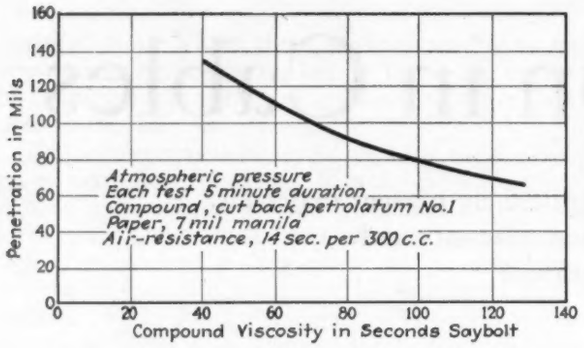

Penetration in Mils
Compound Viscosity in Seconds Saybolt
Atmospheric pressure
Each test 5 minute duration
Compound, cut back petrolatum No.1
Paper, 7 mil manila
Air-resistance, 14 sec. per 300 c.c.

Fig. 3—Effect of compound viscosity on penetration through manila

While the viscosity of any compound can be decreased by raising the saturating temperature, this method of improving penetration is limited by the increased deterioration of the compound at the higher temperature. Both viscosity and deterioration at the saturating temperature are important factors in selecting an impregnating compound.

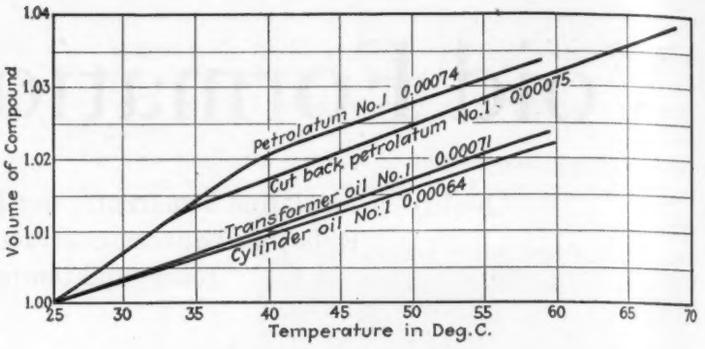


Fig. 4—Volume-temperature characteristics of typical compounds

Change of volume with temperature is approximately uniform for all the compounds above 40 deg. C., but the rate of the two petrolatums doubles at their approximate solidification temperature and maintains that rate down to 25 deg. This disadvantage is but slightly improved by "cutting back" with a thin oil. The contraction is more than ten times that of paper, copper or lead.

saturation, the air content of the insulation should not exceed 2.5 per cent of the compound volume. If the compound is put under air pressure during saturation the air content of the insulation may reach 10 per cent or more, but need not exceed 3 per cent if done properly. It therefore seems a reasonable assumption that voids will be present at the end of the saturation only if the time of saturation is insufficient for complete penetration. All air values are at atmospheric pressure.

Contraction During Cooling

After saturation the compound temperature and hence that of the cable is lowered. As the compound cools it decreases in volume, and more compound must work in through the insulation from the excess compound around the cable to prevent the formation of voids in the insulation. The volume-temperature characteristics of a few representative compounds are shown in Fig. 4.

While no complete curves can be given at this time for compounds containing rosin or rosin oil, determinations of the total expansion between 25 and 80 deg. C. indicate that such compounds show about 10 per cent less contraction than those without rosin.

As the compound cools, it also gradually stiffens, or increases in viscosity. Some viscosity-temperature curves for several typical compounds are shown in Fig. 5. From these data it may be concluded that when the shrinkage is more rapid than the movement of the compounds through the insulation voids will begin to form in the insulation, that when it is not more rapid no voids will be formed, and when it is less rapid any voids already formed will be decreased in size.

It is difficult to see how the air content of the compound, if it does not exceed 10 per cent, can do more than merely fill the voids when they form. In a cable of modern impregnation the air content of the compound should not in itself be the cause of void formation.

The denseness of the paper insulation apparently influences void formation through segregation of compound and movement of compound. If the voids are caused by compound shrinkage, the void content per unit volume of insulation will be directly proportional to the amount of compound per unit volume. If relatively large interstices are included in the paper arrangement, the segregation at these points will produce a void formation that may easily be double that throughout the remainder of the insulation, as the ratio of compound to total insulation is usually around 50 per cent. Under some conditions, the only voids present may be at these points. While such segregation may be caused by excessively loose taping, probably the most familiar instance is along the inside edges of the fillers in three-conductor belted cable. This is the usual location of *X* when found. Incidentally, this suggests that the well-known greater ionization and shorter life of three-conductor belted cable compared with single conductor or shielded three-conductor is due to the same cause. If so, this constitutes the principal limitation of three-conductor belted cable for other than medium voltages.

Decreased denseness of paper insulation should also favor void elimination. This can be accomplished by looser taping and by decreasing the air resistance of the paper, but with a realization that the latter method

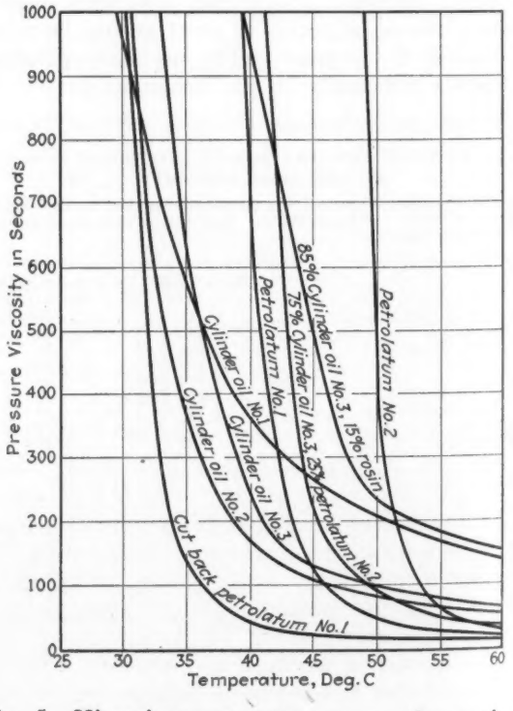


Fig. 5—Viscosity-temperature curves for typical compounds

While none of these compounds plotted shows a definite solidification temperature like water, their viscosity increases very rapidly below the critical temperature, which is generally more definite with petrolatums than with cylinder oils.

appears more favorable, since the former is liable to cause undue concentration of compound.

Fig. 6 shows the influence of the viscosity and contraction characteristics of Figs. 5 and 4 upon the formation of voids during the cooling period. While these curves have certain definite limitations, they afford an interesting comparison of types of compound and cooling rates. The cooling curves *A* and *B* were assumed as reasonably representative of a high and low rate of cooling respectively. In the factory tanks the cooling rate can be somewhat controlled by water jackets in the tank walls and circulation of compound through cooling coils.

TABLE II—VOID VOLUME IN COMPLETED CABLE

All weighings made after overflow of compound had ceased.
All cable saturated with cut-back petrolatum No. 1

Test Temperature in Deg. C.	Compound Expelled from Sample in CC.	Volume of Voids at 25 Deg. C in Per Cent of Total Compound Volume
3/350,000 circ. mil 10x5 in. / 32		
40	0	
60	7.78	2.4
80	15.50	
100	15.42	
1/2/0 9 in. / 32		
40	.31	
60	1.17	
80	1.19	
100	1.16	1.0
1/750,000 circ. mil 24 in. / 32		
55	10.4	
68	5.5	0.9

The compound shrinkage curves were derived by combination of the cooling curve with the volume-temperature relations of Fig. 4, and the compound movement curves were derived by combination of the cooling curve with the viscosity-temperature curve of Fig. 5. (See Appendix I.)

Comparison of the *A* and *B* curves of Fig. 6 indicates the danger of selecting the rate and duration of the cooling period without proper consideration of the compound viscosity and contraction. It is evident that the acceleration of compound penetration or movement by pressure (Fig. 1) is applicable to the cooling period as well as saturation. The obvious limitation of the curves of Fig. 6 is that the compound movement is based on viscosity tests rather than movement through actual insulation. While this is no objection when merely comparing compounds or cooling curves, it prevents direct application of the curves to practice. Thus, while Fig. 6 shows *A*1 to eliminate voids at 200 hours, against 400 hours for *A*3, the real significance of the comparison is that for that particular cooling rate and the same type of cable *A*1 should eliminate voids in half the time taken by *A*3.

Determining Void Volume

A possible simple method of determining void volume without the laborious collection of movement data through insulation is to ascertain the void volume resulting from a certain compound and a known impregnation procedure, and to adjust the scale of the movement curve so the height of the shaded area will agree with the known void volume. Then if the contraction and the movement scales are kept relatively the same, and if the movement of the compound through the insulation is assumed proportional to its movement through the viscosimeter, the curves should represent actual conditions, no matter what the compound or cooling rate. However, any change in the type of cable or size of cross-section would necessitate another void determination and adjustment of the movement scale.

A simple and direct method of void volume determination suggests itself: A short sample, say 12 in., of the completed cable with one end sealed and the other open is kept in a vertical position with the open end up at, say, 40 deg. C. until compound has ceased to flow from the open end. The procedure is then repeated at, say, 60 deg. C., etc. The compound overflowing at each temperature is weighed and the void volume is readily calculated from these observations. The method has several sources of error, but seems worthy of consideration. A few preliminary determinations are given in Table II. (See also Appendix II.)

The difference shown above between single and three-conductor cable is of incidental interest, in connection

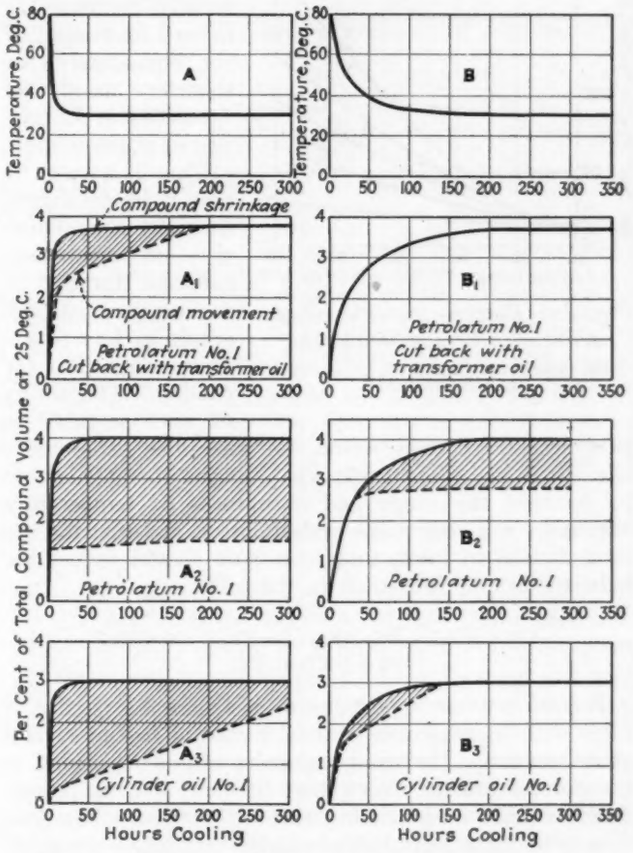


Fig. 6—Relative shrinkage and movement of three compounds at two rates of cooling

As the solid curves, subscripts 1-3, represent the compound shrinkage and the dotted curves the compound movement in through the insulation, voids must form whenever the latter is below the former; i.e., whenever the movement lags behind the shrinkage. All shaded portions represent the presence of voids, the difference between the curves at any particular time being the void volume at that time. With the cooling rate *A*, while the shrinkage of the cut-back petrolatum *A*1 exceeds the movement at first, the shrinkage ceases at constant temperature, while the movement continues, finally overtaking the shrinkage and filling the voids at 200 hours. If the cooling period were terminated when the temperature become constant, there would be a void volume of 0.4 per cent of the total compound volume, while a continuation of the cooling period at constant temperature would eliminate the voids.

The greater stiffness of the petrolatum *A*2 at the lower temperatures makes its movement so slight in this range that no reduction in void volume is appreciable, regardless of the length of the cool. This cable should contain materially more voids than *A*1.

The cylinder oil *A*3 shows the effect of its flatter viscosity curve (of Fig. 5). Its movement, though relatively less at first, exceeds *A*1 at 30 deg. C,, with the prospect of ultimate void elimination.

The effect of the slower rate of cooling, *B* curves, is that the void formation is materially decreased with all three compounds, although the petrolatum, *B*2, still shows no indication of eventual void elimination. It is clear that the cut-back petrolatum and the cylinder oil could be stopped as soon as their temperature became constant.

with the common experience as to ionization and life. All agree in indicating more voids in the three-conductor cable, probably because of the filling.

When cable cools in service the relation of compound viscosity and contraction in forming voids is much as shown in Fig. 6, with the following exceptions: (1) The rate of cooling in service may be more rapid than in the factory on account of the smaller mass of compound involved, which gives greater void formation; (2) even voids existing only during cooling mean ionization and incipient trouble; (3) coolings after lead expansion are more liable to produce voids because the total volume within the sheath has been increased without increase in compound volume, and (4) sheath expansion, by lowering the pressure "behind" the compound, may materially decrease the inward movement of the compound and therefore cause void formation in the interior of the insulation.

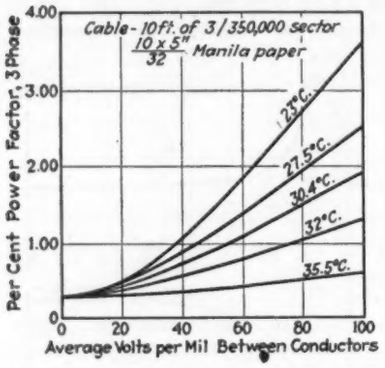


Fig. 7 — Power - factor - voltage curves of three-conductor cable

Void conditions improved by increase of temperature

Thus it appears that it is insufficient to select a combination of compound, rate and duration of cooling, etc., that will result in freedom from voids after the cooling. The ability of such a cable to pass acceptance tests would not guarantee satisfactory life. It is also evident that whatever the operator can do to decrease the range and abruptness of temperature variations will reduce his cable failures, and that the use of a thin oil in joints under pressure should reduce the liability of void formation in the cable.

Test Data Reconciled by Variation in Compounds

It is of extreme importance to determine the quality of cable without subjecting several thousand feet to several years' service. The most important tests of this kind in present use are the overvoltage life test and the power-factor-voltage or ionization test. The former has been found to be a reasonably reliable indication of cable quality, but has the disadvantage of being slow and destructive to the cable tested. The second is reasonably quick and is not destructive, but does not always agree with the life test.

The principal differences between such tests and service conditions are (a) the test temperature changes are less severe; (b) the test cable is usually open at both ends. These reduce the chances of voids being produced during the test, especially by expansion of the sheath.

Application of the above viscosity-contraction relations to these tests is of considerable aid in properly interpreting them. For instance, these relations would indicate that relatively small temperature changes between 25 and 35 deg. C. should have material influence on the voids in the insulation and, therefore, on the ionization and life tests.

The power-factor-voltage curves on three-conductor cable saturated with cut back petrolatum shown in Fig. 7 indicate that increase of temperature from 24 to 35 deg. C. materially improves the void conditions in the insulation.

In determining the effect of similar temperature changes on the life, it should first be noted that the actual insulation temperature of a so-called room temperature life test may be 35 deg. C. at a test voltage between two and three times the operating voltage. Table III gives some temperatures actually obtained.

The elementary viscosity-contraction - temperature relations suggest that a decrease of life test temperature of only a few degrees ought to decrease the cable life by increasing the void content. The figures of Table IV show that a decrease in temperature of only 5 deg. C. is often sufficient to decrease the life 30 per cent. It would be expected that this influence of temperature would vary for different compounds, according to their viscosity-temperature characteristic. While such tests are in progress no results can yet be reported. It is suggested that this may account, at least in part, for occasional disagreement between the ionization test and the life test, especially with cable of different compounds or manufacture. The life test temperature

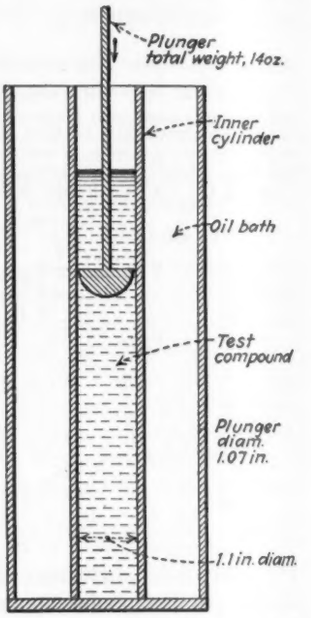


Fig. 8 — Viscosimeter for compound testing

As no satisfactory equipment could be found for this purpose, this apparatus was developed. The inner cylinder was filled with compound and the outer chamber with an oil bath for temperature equalization. As the plunger descends by gravity the compound is forced up through the annular clearance between the plunger and the inner cylinder, and the plunger was arranged to energize a recording voltmeter at the end of its travel, permitting tests to be started during the day and completed at night without attendance.

TABLE III—REPRESENTATIVE TEMPERATURES OF OVERVOLTAGE LIFE TEST SAMPLES

All Samples 10 ft. Under Lead	Deg. C. Ambient	Sheath	Conductor*
A—3/350,000 $\frac{10x5}{32}$ after twenty hours, at 70 kv. three-phase	21	30	38
B—3/350,000 $\frac{10x5}{32}$ after twenty hours, at 70 kv. three-phase	21.5	34	44
C—1/ 2/0 9/32 in. after 30 hours, at 45 kv.....	23	28	33

*Temperature determined by conductor resistance. Other temperatures by thermometer.

TABLE IV—INFLUENCE OF TEMPERATURE ON LIFE

All samples 10 ft. under lead, manila paper.
All temperatures the average of conductor and sheath.

Sample No.	Cable	Ambient	Temp.	Test Voltage, Kv.	Time on Test, Hours
1	3/350,000 10x5 / 32	Running water	23 deg. C.	70	20
		Running water	29	89	20
		Ice pack	17	89	2*
2	Same as No. 1	Room	34†	89	66*
3	Same as No. 1	Melting ice	17–24	89	28*
4	2/0 9/32	Room	29‡	45	220*
5	Same as No. 4	Running water	23	45	30*

*—Cable failure. †—Sheath temperature 29 deg. C. ‡—Sheath temperature 27 deg. C.
All cables of same dimensions received same saturation.

Appendix I—Derivation of the Curves of Fig. 6

The compound shrinkage curves were derived by combination of the cooling curve with the volume-temperature relations of Fig. 4. For any one time of cooling, the corresponding compound temperature given by the cooling curve was applied to Fig. 4 and the corresponding volume noted. By summation of the increments of volume change, the total shrinkage is determined as plotted in Fig. 6.

The compound movement curves were derived by combination of the cooling curve with the viscosity-temperature curves of Fig. 5. For any one time of cooling, the corresponding compound temperature given by the cooling curve was applied to Fig. 5 and the corresponding viscosity noted. The viscosity is given on Fig. 5 as the time necessary for a given volume of compound to flow through a given orifice. Therefore, the reciprocal of this figure should be directly proportional to the rate of flow (volume per unit time) of the compound. While this figure is not the rate of flow through actual insulation, it should be relative and, therefore, suitable for comparisons of compounds and cooling rates. A figure proportional to the total flow can be obtained from summation of the increments of the change in rate of flow. This represents the total movement throughout the period of cooling that is permitted by the insulation denseness and the compound viscosity.

Before this can be compared with the compound shrinkage as in Fig. 6, a proper proportionality factor must be determined. This was done by assuming a definite void content of 0.9 per cent after 50 hours of *A* cooling with the cut-back petrolatum. This is believed to be sufficiently representative for comparison of compounds and cooling rates. The same factor was, of course, used for all the other curves.

When the permissible movement as determined above was less than the shrinkage, it was plotted as the actual movement. When it was greater than the shrinkage, the actual movement was assumed equal to latter and so plotted on Fig. 6. It is physically impossible for the compound to move into the insulation faster than the compound shrinks.

Appendix II—Determination of Void Content of Completed Cable

The figures given in Table II were determined by assuming that (1) the compound expansion and contraction follow the relation given by Fig. 4; (2) all overflow from the sample is caused by expansion of compound; (3) when the compound begins to overflow from the sample the voids are eliminated—filled by expansion. This, of course, will not be true if the air content exceeds 10 per cent.

While the exactness of the last assumption may be questionable, it will at least serve for a few preliminary comparisons.

Let C_0 = total cubic-centimeters of compound overflowing below temperature 1.

ΔC = total cubic-centimeters of compound overflowing between temperatures 1 and 2.

V_1 = volume of compound in sample at temperature 1 in terms of the volume at 25 deg. C.

V_2 = volume of compound in sample at temperature 2 in terms of the volume at 25 deg. C.

Both V_1 and V_2 are read off the curves of Fig. 4, knowing the compound and the temperatures.

Total volume of compound in sample $= \frac{\Delta C}{V_2 - V_1}$

Expansion below temperature 1 $= \frac{C_0 (V_2 - V_1)}{\Delta C}$

Volume at beginning of overflow $= V_1 - \frac{C_0 (V_2 - V_1)}{\Delta C}$

Therefore, void volume at 25 deg. C. in per cent of total compound volume $= \left[\left(V_1 - \frac{C_0 (V_2 - V_1)}{\Delta C} \right) - 1 \right] \times 100$

The void content in per cent of the total insulation will be approximately half or less of the figures given in Table II.

One advantage of this method is that the sample dimensions are not necessary, the only necessary determinations being the quantity of compound expelled and the temperatures. Determinations need only be made at two temperatures. Those given in Table II at additional temperatures are of interest in showing how closely the overflow follows the relation of Fig. 4.

may be 5 to 10 deg. C. higher than the ionization tests and the resulting influence on the void condition may be different for different compounds used in the samples of cables tested.

While the overvoltage life test is generally believed to give a reasonably reliable indication of life in service, the curves of Fig. 6 suggest that there might be some compounds that would be voidless in the cable at the constant temperature of the life test, but would form voids during the cooling periods experienced in service. In such a case, the life test would not give a reliable indication of the insulation quality. It may be found that the reliability of the life test can be improved by a suitable periodic variation of the temperature. In general, it is believed that further investigation of the life and ionization tests along these lines may add materially to the usefulness of both tests. It may even be found that the principal difficulty with the latter test is merely lack of proper interpretation.

Conclusions

It has probably been noted that no attempt has been made to include in the above data any conclusive proof of the influence of the compound viscosity-contraction-temperature relations on the service of the cable or even on the overvoltage life test. Such proof to be conclusive must include extensive tests on cable comparing compounds, impregnating procedures, etc. As available data of this nature are not sufficiently complete to be conclusive, it has been thought best to omit them altogether. It can be said, however, that such data as have been collected to date, including several different compounds and impregnating procedures, confirm the suggested controlling influence of the above-mentioned compound characteristics on the insulation quality.

The question of rosin or no rosin in the impregnating compound has received considerable attention for years without any generally accepted conclusion being reached. It has been said that the principal advantage of a rosin content is that the compound is less easily displaced by the dielectric stress. If this is true, a properly saturated cable should need no rosin, since the compound could not be displaced anyway. This may be one reason why it is so difficult to get a conclusive story, either in favor of rosin or against it.

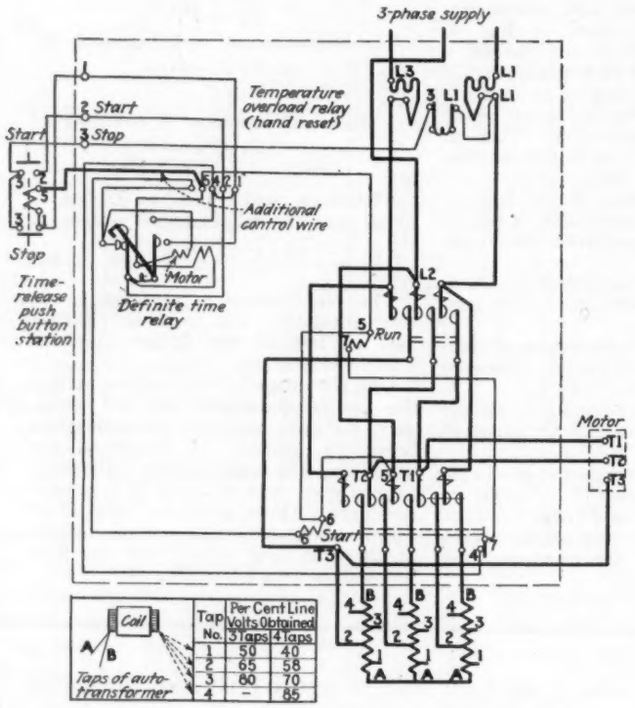
The test results given and discussed above suggest, in general (1) that the quality of impregnated paper insulation is not yet limited by the type of materials in use; (2) that material improvement in insulation quality can be obtained by more proper application of the fundamental relations between the contraction, viscosity and temperature of the compound, and (3) that, therefore, these relations should be more completely determined by research work.

It is believed that a more general understanding of these relations among all concerned will go far toward rationalizing the manufacture and use of impregnated paper insulation.

Time-Delay Undervoltage Device Minimizes Interruptions

By L. C. Hardesty
Industrial Control Engineering Department
General Electric Company

A DEVELOPMENT in push-button stations controlling standard magnetic starters and incorporating a time-delay element makes it unnecessary to add time-delay attachments to the starters themselves. The application of such a station to the reduced-voltage type of starting compensator requires consideration of several factors. If a connection is made, using the standard wiring of the compensator, and a voltage dip occurs, the compensator contacts will open, and, if voltage returns before the push-button station trips, the starting contactor on the compensator will close, and the compensator will go through the regular starting sequence, as it would if the motor were being started from rest.



Standard low-voltage automatic compensator equipped with time-release control

The substitution of a standard time-release push-button switch for the usual start-stop type and the addition of but one control wire between the switch and the definite-time relay permits adaptation of standard automatic compensator to time-release characteristics.

This dropping back to reduced voltage on a voltage dip might, in some cases, be objectionable. The amount of inconvenience would depend on the compensator tap used and the amount of load on the motor. If the motor were driving one of a series of belt conveyors, and it should be thrown back on partial voltage, the speed might be reduced enough to cause a perceptible pile-up of material on the belt. In such cases, a slight speed reduction on the motor might be objectionable, but it is probable that, in the majority of instances, a slight speed reduction after a voltage dip would not cause any difficulty.

In cases of trouble, however, the standard automatic compensator can be used by adding but one control wire. The accompanying diagram shows the connections of standard low-voltage automatic compensator equipped with a time-release push-button station. If a voltage dip occurs, the "run" contactor will open, but if voltage returns before the push-button station trips, the "run" contactor will close again, putting full voltage back on the motor.

Cable Sheath Troubles at Duct Edges

By C. H. Shaw
Engineer Distribution and Installation Department,
New York Edison Company

ONE OF the most common sources of trouble in the operation of underground cables is the abrasion of the lead sheath of the cables at the point where they emerge from the conduits in the manholes. The daily change in load results in a heating and a subsequent cooling of the conductors of the cable, which causes expansion and contraction that produces an abrasion at the duct edge usually at both ends of every cable section.

In existing systems, where adequate provision has not been made for taking care of the expansion of the feeder cables, it is a difficult matter to eliminate this duct edge condition. Many engineers of underground distribution systems have failed to realize that this abrasion is largely a function of the design and method of installation of the cables in the manholes. If the manholes are constructed of such a shape that an even movement of the cable is permissible during its expansion cycle and if the cables are trained and supported on the manhole walls in a proper manner there will be little or no cause for worry as to the condition of the cables at the duct edge.

The following data have been prepared indicating the relatively insignificant importance of duct edge injury on one of the largest underground cable systems in the world, that of the New York Edison Company. On the system in question the amount of low-tension feeder cables has increased from 3,400,000 ft. at the end of 1922 to 5,200,000 ft. at the end of 1927. This cable is installed in conduits with an average length of approximately 200 ft. each, and therefore represents more than 55,000 duct edge exposures:

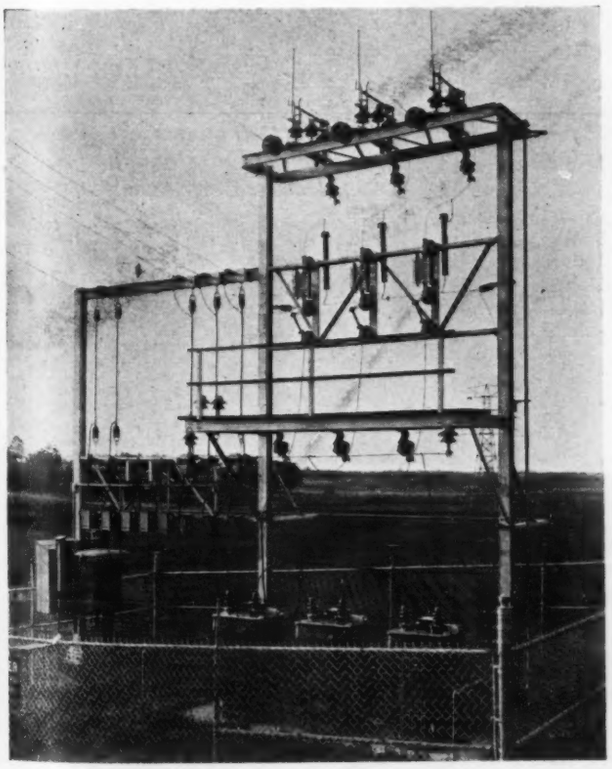
Point of Trouble	1922	1923	1924	1925	1926	1927
At splice	29	6	2	6	9	3
Between splice and duct	12	7	4	3	6	10
In duct	6	13	14	23	64	71
At duct edge	8	5	2	2	1	2

It will be seen that there has been an appreciable reduction in the number of troubles that have been located at the duct edge. This has been due to a continuous improvement in the general condition of the underground cable system as well as to the reconstruction of a considerable number of manholes that had been built in former years when the knowledge of cable operation was not as complete as at present and before the proper shape of manholes for this type of cable installation had been determined. Incidentally, the unusually large number of failures of cable in duct that are indicated in the above tabulation have been due to mechanical injury from sources outside the duct line, such as bull points, etc., and do not indicate any decrease in the quality of the cable insulation. In all of the years there have, of course, been some cases of mechanical injury included in the figures for trouble "in duct." Practically all of the cables described in the preceding paragraph have been protected with zinc fairleaders at the duct edge. It is probable that

the average life of the cables installed in the conduit system exceeds ten years. It is probably impossible to determine in one month, or even in one year, that a new type of manhole design or method of cable racking is entirely satisfactory. There have been placed on the market for the past few years a large number of different types of duct edge protectors. Their installation in existing systems would call for the reconstruction of the duct lines and the same results could be secured for a redesign of the manholes. In new conduit lines about to be constructed there is no need for the use of these devices if the manholes are arranged so as to provide adequate expansion space for the cables. If the manholes, in the ordinary parlance of the underground cable manhole, could be classified as expansion chambers, rather than as manholes, it is probable that much more attention could be given to providing for adequate expansion and contraction of the cables than has heretofore been provided in most underground conduit systems.

Economy in Small Substation

SIMPLICITY and low cost are the distinguishing features of this substation, through which the Wisconsin Public Service Corporation serves the village of Lena, Wis. The primary feed is at 13,800 volts and the secondary output is taken off by one 2,300-volt line and a street lighting circuit. The equipment includes three 75-kva. transformers and a 10-kva. street-lighting regulator. The meter is contained in the box at the left and the instrument transformers may be discerned

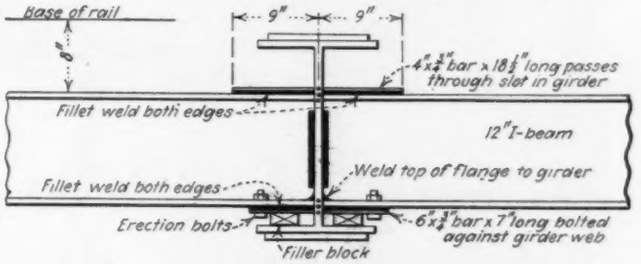


Simplified design reduces installation cost

mounted in the left bay. The use of fused cutouts in place of breakers is to be noted. The substation, with the exception of transformer and instrument equipment, was furnished by the Railway & Industrial Engineering Company.

Electric Welding Cuts Steel Bridge Tonnage One-Third

BY THE use of electric welding the amount of steel required in a Boston & Maine Railroad bridge 175 ft. long now being built at Chicopee Falls, Mass., has been reduced at least 33.3 per cent, according to Gilbert D. Fish, consulting engineer Westinghouse Electric & Manufacturing Company. The design for welding calls for but 80 tons of steel. More than half the saving is in reduction of connection material; only about 25 per cent of the joints have gusset plates, and these gussets are only about one-fifth as large as those needed for riveted joints. Most of the remaining saving is about


Base of rail
9"
9"
4"x3/4" bar x 18 1/2" long passes through slot in girder
Fillet weld both edges
12" I-beam
Weld top of flange to girder
Fillet weld both edges
Erection bolts
6"x3/4" bar x 7" long bolted against girder web
Filler block

Typical welding of stringers to floor beam

equally divided between reduction of tension members due to eliminating allowance for holes and reduction of stringers due to continuity through floor beams. No channels were used. Slot welds ½ in. square in section connect the members to the gussets, and 1.5 in. of one slot is about equivalent to one ⅞-in. rivet in single shear. Triangular fillet welds assist the slot welds and the value of a ⅜-in. fillet weld is about one-half that of a ½-in. x ½-in. slot weld.

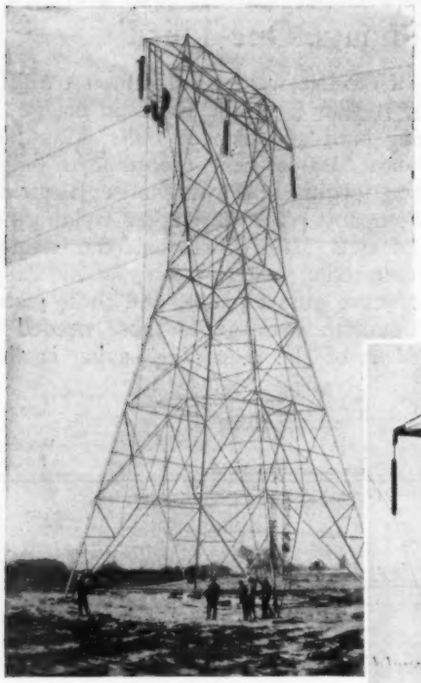
The shear connection for the floor beam is a triangular butt weld with ⅝-in. x 18-in. minimum section. At the end joints the chord tension is developed by butt welding of flanges only and by slot and fillet welds at the splice plates. Among other welding features is the typical connection of stringers to floor beams illustrated herewith. Welding quantities are as follows:

Span of each truss, 134 ft. 8 in.; width center to center of trusses, 17 ft.; number of tracks, one; height center to center of chords, 24 ft. 8 in.; estimated man-days riveting, 50; saving in tonnage by electric welding under E-50 loading, 40 tons.

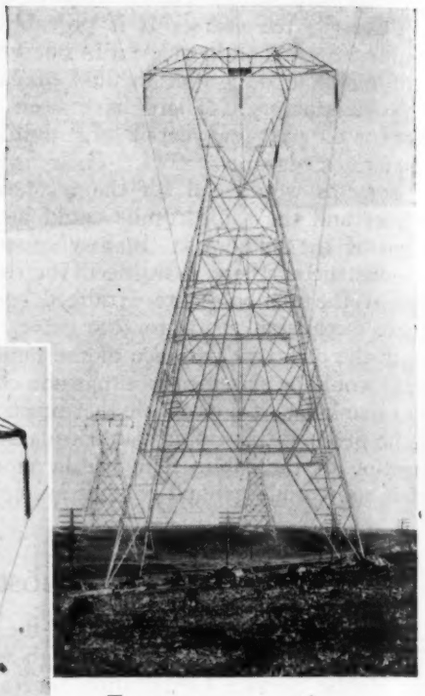
	Shop	Field	Total
38-in. triangular fillet, feet.....	308	562	870
Butt and slot welds, cubic inches...	88	450	538
All kinds of welds, cubic inches....	348	921	1,269

Two welders are employed for all work in shop and field, using a 200-amp. Westinghouse motor-generator set on a truck. The total estimated man-days of welding required on this job is 50. Direct-current welding only is employed. It is expected that this bridge and others to be welded in future will prove somewhat more permanent than riveted ones, because the immovability of the joints removes the chief cause of fatigue. Although weld metal is less ductile than rivet steel, a properly designed and executed welded joint should have greater endurance under stress reversals than a good riveted one, because in the case of the latter the connection members and rivets are subject to slight motions back and forth, frequently beyond the elastic limit. Another factor favoring long life for welded joints is their smoothness and absence of rivet heads, with corresponding ease of painting and lessened tendency to corrode.

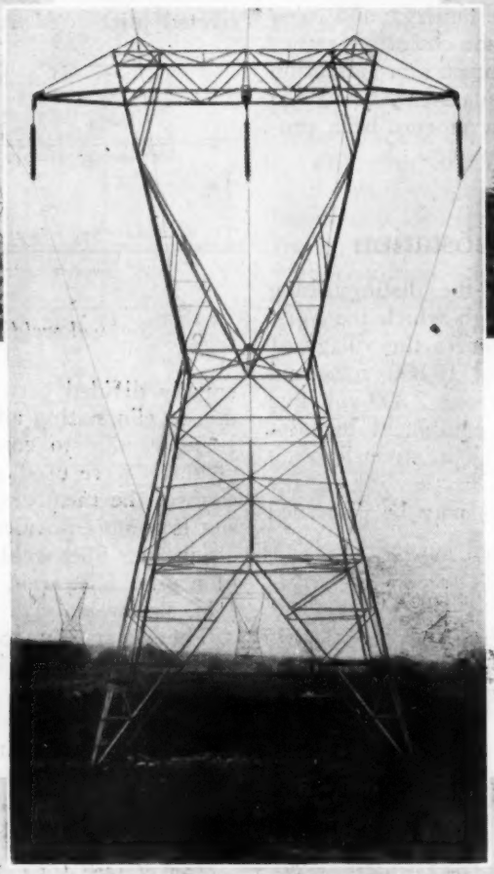
Conowingo Now Operating



Clipping in conductors on 220-kv. tower



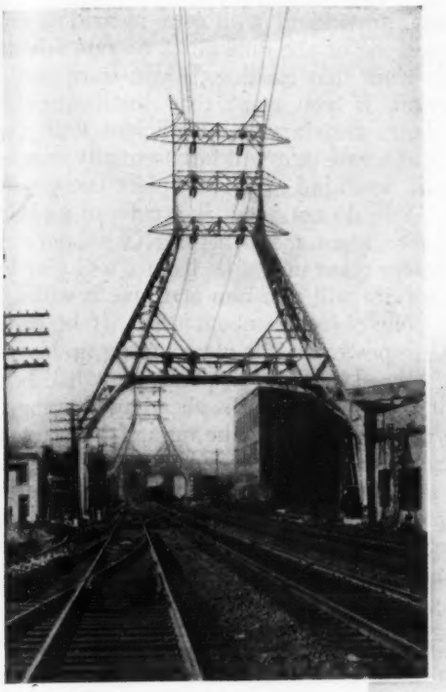
Tangent construction on 220-kv. line



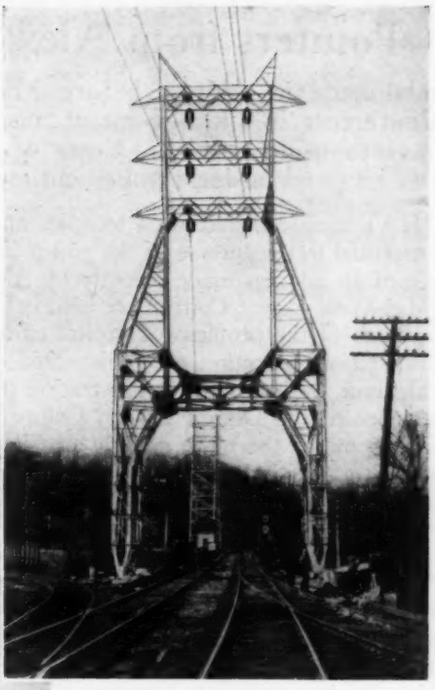
Below—Pulling out conductors with tractors on the Conowingo line

At left—Towers are designed for strength and clearance of conductors

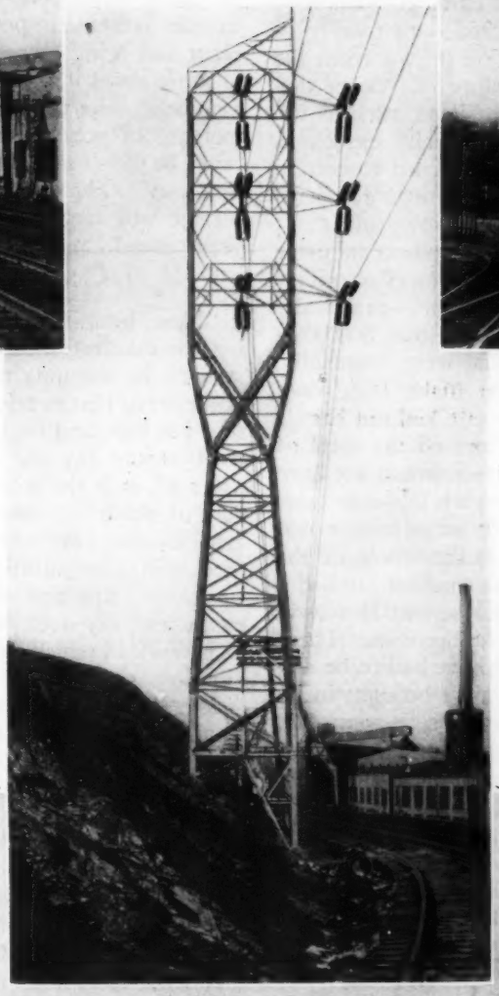
Lines Overhang Railroad



220-kv. line over Reading Railroad

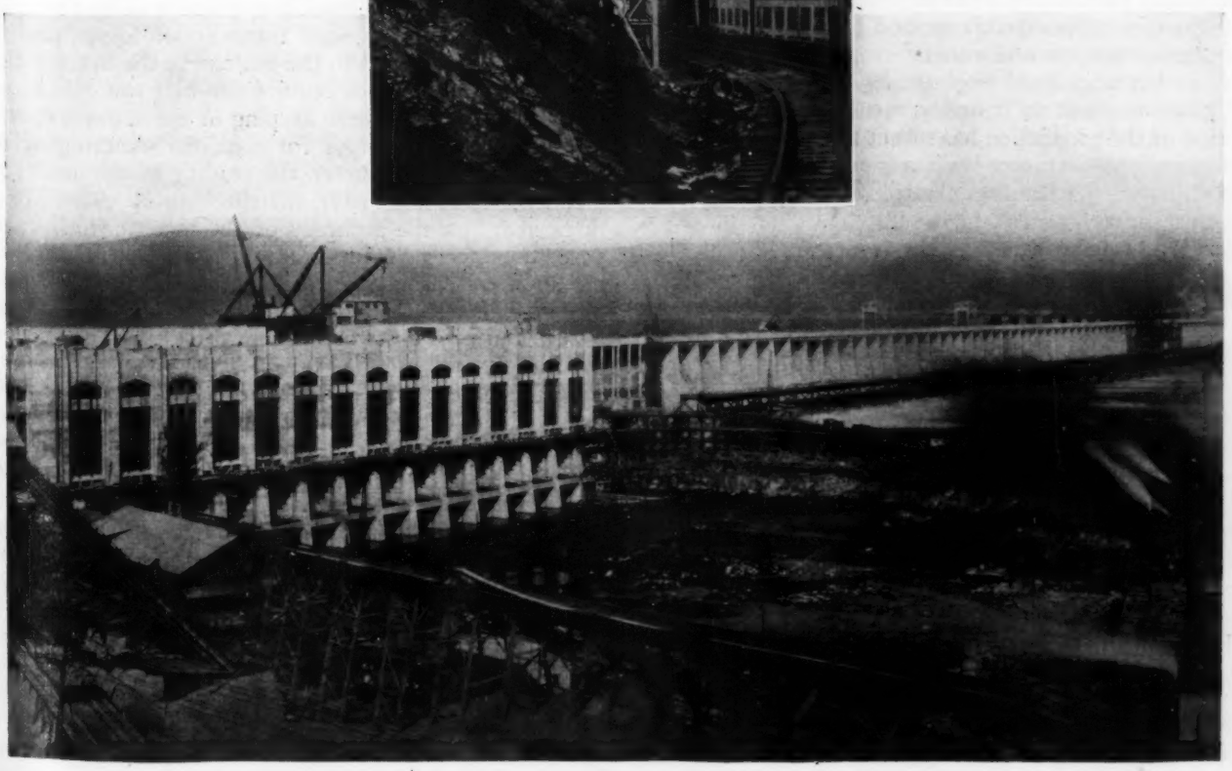


Reading Railroad used as 220-kv. right-of-way



At left — Special 220-kv. structure along Reading Railroad

Below — View of Conowingo Dam and power house



Pointers from Alex Dow

Points made in address before Midwest Power Conference in Chicago hit at misconceptions as to utility affairs. Costs of business and business policy outlined

THAT a wise blending of technics and economics is essential to the success of the power industry was the theme of an address made recently by Alex Dow before the Mid-West Power Conference held in Chicago. Various phases of the problem of capital costs in relation to central-station operation were discussed—not merely in the abstract, but with ample illustration drawn from the experience of the Detroit Edison Company. After discussing some of the more general problems, such as the presence in the industry of a few financial exploiters seeking only personal profit, Mr. Dow turned to certain aspects of the problem of maintaining earnings at a level corresponding with the growth in capital investment:

"The response to good economics in the power industry becomes translated into terms of bigger power earnings. If we did not sell the 800,000,000 kw.-hr.—practically without exception the people who bought that 800,000,000 kw.-hr. last year were concerns that were financially, technically and mechanically able to make their own power and would have done so if the rate had not been a factor—had we not sold this power out of the total of 1,800,000,000 kw.-hr. that we did sell, we would not have been able to give such good service or such low-rate service to other classes of customers. The actual cost would have increased in such a manner that the whole of the general public, right clear down to the smallest kind of a residential customer, would have been served less well, less liberally and almost certainly at higher cost. There would have been overhead that would have had to be distributed that wasn't necessary and wasn't brought in by this increased business. These sales were to some 360 customers; only 370 accounts to keep open, all of them prompt and payable, all of them very simple, all of them buying untransformed current and taking care of their own transformation and conversions, requiring nothing from us but occasional engineering advice, and having that given to them as honestly as we knew how. The addition of the production has meant to us a big economic advantage and that economic advantage has not been grabbed by us, but has been distributed as it ought to be, over our entire business, to the benefit of our public at large. And this business, at the lowest average rate, has always carried a good share of the profit and in many years has been the most profitable business.

Policy Toward Different Classes of Service

"Now, I want to point out to you that the economics of the power industry are very much affected by your policy toward the different classes of service. If you are going to serve your home community; if, in point of fact, you are going to furnish exceptional service at an acceptable price to all classes of your industry, you not only have the duty laid upon you to have your rate schedule so co-ordinated that there is no evidence and no sign of discrimination, but you have to meet the problem of dealing with the big man who can make his own current and you have got to sell to him at a price that is below his legitimate costs. He will break even with you; if you will sell to him at the price at which he thinks he can make it himself, as a rule you can do business. You cannot, of course, go trading with each individual man, and therein comes one of the difficulties of rate schedule making. If you want that backlog, if you want that increased production, if you want that justification for larger power plants and large and efficient units, you have to handle it at a rate that will be essentially competitive with what the best kind of private plant can produce the service for. You do not need, as a rule, to go below it, because the intelligent manufacturer, who does not want to run a power plant unless he has to, will give you as much as the service will cost him and give it willingly.

"There is just one objection about that. If he had to have an increase in power and he were setting up his own plant and being served by his own plant, he would begin to think about it at least six months ahead and arrange to finance it, whereas with service like ours if he wants an increase of power, he wants it yesterday and kicks because he didn't get it and we have to try to serve him just that way. That means that we have to guess what the service will require. We have to develop two or three years ahead.

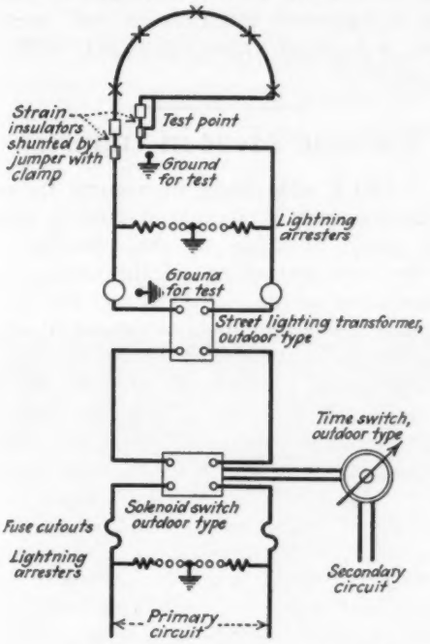
Case of the Small Customer

"Now, jumping for a minute to the other class of service, the smallest, most troublesome service, the small consumer—he amounts to a great deal. In our district we don't serve him nearly as much current as we would like to serve him, and we know he is buying more every year, or I should say she is buying more every year. For, after all, it is the woman in the house who controls that sort of thing. Actual earnings from that source in the last calendar year were nearly $11,000,000, and that is a nice item, amounting to about 23 per cent of our total business. But that is got from a great multiplicity of customers, say over 400,000, and it is troublesome work. It is work in which the production cost and the transmission losses are almost negligible."

Mr. Dow pointed out that the cost of fuel is relatively small in relation to some other items. "All transmission losses, all transformation standby losses, such as idle losses in the multiplicity of line transformers; the actual generating of the necessary transmission losses, plus the actual service metered to the customer; the average residence customer, do not require one-half ton of coal per annum, whereas the mere keeping of the account open at the present market rates for coal, the metering of the service, putting in a meter, the reading of the meter, the maintenance of the meter, the checking up every two or three years on the accuracy of the meter, which is imposed upon us by the public utility regulation; the following up of collections, the rendering of bills, the providing of convenient places where the bills can be paid, all that sort of business costs us roughly three times as much as the fuel.

"Of course, there is little economic back-kick from that. If you are going to benefit the ultimate consumer, who is ultimately, of course, the man who consumes service in his house, if you are going to benefit him by getting cheap power at the expense of the general taxpayer, you are barking up the wrong tree. If our fuel costs were wiped out altogether and the fuel costs given to the residential customer; in other words, if we could allocate our coal costs and collect from a beneficent government at Washington that proportion of the coal bill that represented service to the small consumer, the residence consumer in particular, if we could do that, we would be able to cut that rate 8 per cent. We know that one way to bring down the residential service rate is to encourage

Series Circuit with Outdoor Transformers and Switches



Standards of West Penn System

its use, because it is the failure to use the large investment that you must make for service when it is first installed, service afflicted with what we have for convenience called a dispersion factor; it is the difficulty of getting sufficient use of the investment that is the real limit upon the rate. If the use were doubled, the investment would not be doubled, because the form of the load curve would always of necessity be altered in a beneficial way. And that increased use is the real economic answer to the problem of serving the small consumer."

Financial Exploiters on Wane

In the course of his address Mr. Dow also discussed the utility business from the point of view of a utility executive interested in proper methods of financing and operating properties. Some of his very pertinent comment is as follows:

"We still have with us the financial groups, to whom, especially to the newcomers in the industry, the industry is merely one of many means to make money. In other words, they measure the success of a public utility service by its contributions to their personal or group coffers, by the emoluments which they receive, directly or indirectly, by the opportunities for financial exploitation, and so on. We suffer from the activities of these groups. It is true that most of them have butted in and it is true that if they live long enough with us they either learn differently and behave in a better way or they get, metaphorically speaking, their necks broken. But we can't always be educating the people who butt in to our business.

"I have observed that in a great many recent cases the financial grabbing that has been found fault with has come from people or groups whose attitude toward public utility service at large is that of the attitude of the exploiter, the man who says, 'This thing can be dealt with thus and so, and I can close out the account with a handsome profit.'

"Now, so long as profits can be made and so long as the rules of the game make it possible that these profits may be very large and still stay inside the law, just so long will we have these raids upon us. Now, when these people, as happens occasionally, get out with a loss, a much-needed lesson is taught, and those of us who remain in the industry have a chance to clean up the mess. But there is a limit to all these things, and I am not so sure but that one of the byproducts of recent and present public interest, very much overstimulated, of course, by the political gentlemen who want to advertise themselves, will be more caution on the part of these exploiting groups.

"Present laws, without any particular assistance from legislative bodies, can be used to deal with the worst offenders. And the steadying of the utilities; that is, the forcing of them into common action, is very helpful in avoiding this kind of economic disturbance, a disturbance which results inevitably when the management of a big public service is in the interests of profit making only."

Sign Exhibit Creates Sales

By R. B. Brown, Jr.
Illuminating Engineer
Edison Electric Illuminating Company of Boston

FIFTY-SEVEN electric signs with an aggregate connected load of 120 kw. were sold in the Boston Edison territory last fall during a six weeks' series of electric shows held by the company in suburban cities and towns. A total of 114 active prospects for sign business was also the fruit of the displays, and the estimated merchandising value of the signs to their manufacturers was approximately $25,000. The added revenue to the Edison company from the load represented by these 57 signs is estimated at about $8,000 a year, assuming an average run of four hours a night. The cost of the exhibit to the company was, roughly, $1,000 for the six weeks.

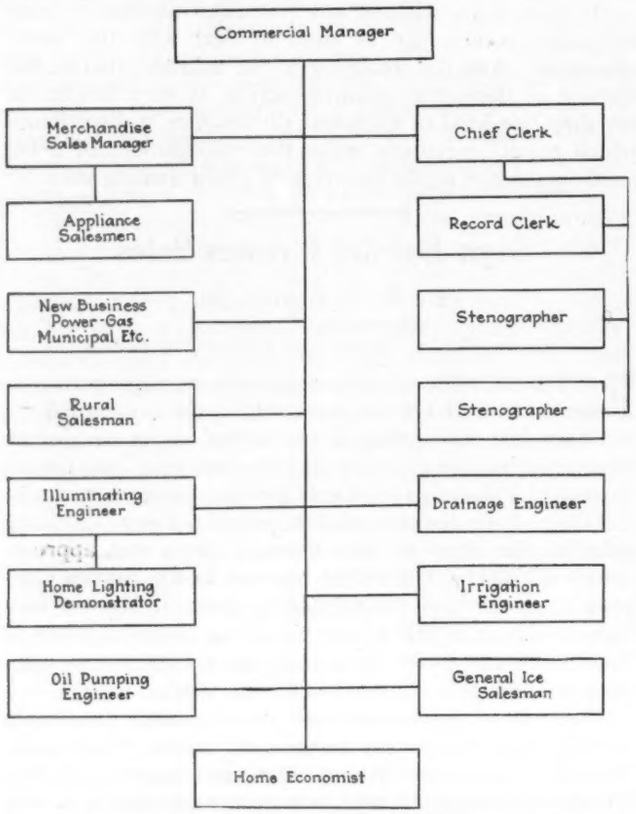
Two edison employees were in attendance practically all the time, the display being open to the public daily from 2 to 10 p.m. About 30 manufacturers of electric signs participated, and most of these were the owners of local sign plants, whose products thus became familiar to visitors to the shows as neighborhood commodities.

Fifty-seven electric signs were sold by massed display in six weeks

The sign manufacturers co-operated by furnishing signs for the exhibit, but were put to no other expense than the cost of transportation of their products to and from the shows. Three or four manufacturers' representatives were also in regular attendance at the booth.

A Flexible Commercial Department Organization

IN CARRYING out the sale of electric service to nearly 1,800 different communities, located in states from Maine to the Gulf of Mexico, the subsidiary companies of the Middle West Utilities Company naturally require a somewhat flexible sales organization. Local conditions differ in the various communities and the relations of local commercial departments with the commercial department of the Middle West Utilities Company are such that the local sales department is free to plan and carry out its sales program independently.



Suggested organization chart for subsidiaries of Middle West Utilities Company

The varied types of territories served are indicated by the provision for oil pumping, drainage and irrigation engineers in some departments.

With the view to providing a basis for building up a department to meet these local conditions, C. J. Eaton, commercial manager of the Middle West Utilities Company, has suggested the tentative form of commercial organization shown in the accompanying illustration. It is not intended that local departments shall be set up rigidly along these lines, but in so far as conditions permit the department will be patterned after the suggested organization.

Where a group of communities are so located geographically that sales programs can be directed and conducted from a central office the commercial department for this group is built up under the supervision of a commercial manager whose headquarters are at the general offices of that particular subsidiary. Primarily, the relations of these local commercial departments with the commercial department of the Middle West Utilities Company are such that the latter acts in an advisory and consulting capacity with the operating company in promoting the sale of electric service. Mr. Eaton states that he has found that a certain amount of standardization has made for economy and efficiency in the operation of the local departments, but such a standardization should not be carried too far as it would tend to hamper and discourage independent initiative as well as set up, in some cases, a form of organization not at all suited to the local situation.

Electric Heat in Industry

A VALUABLE educational instrument for promoting the development of industrial electric heating has just been made available to the electrical industry. Through the combined efforts of the national industrial heating committee of the N.E.L.A. and the Detroit Edison Company a five-reel motion picture film, "Electric Heat in Industry," has been made and is being released by the committee on either a sale or rental basis.

This film, which is 4,500 ft. long and requires about 50 minutes to exhibit, covers all of the principal electric heat-treating applications, enameling, steel melting, and so forth. It has taken in nineteen different industrial plants and shows the actual operation of the latest electric heating applications installed in these manufacturing plants to effect refinements and economies in production processes. The film has been stripped of all non-essentials and the captions have been written with a view to brevity, but emphasizing the benefits to the user through savings in production costs and increased profits because of improved quality, reduction of spoilage and greater uniformity.

For the power company this film will make it possible to visualize to industrial customers what electric heating is accomplishing in other industries throughout the country. For the industrial plant which has a heat-treating problem the film will help to show how this problem has been solved elsewhere or suggests a possible improvement over the existing process.

The original picture was taken under the personal direction of H. J. Hall of the Detroit Edison Company and represents several months of intensive planning and negotiation with industrial plants before final releases could be secured. It was first shown publicly at the meeting of the American Society of Steel Treaters in Detroit last fall under the auspices of the N.E.L.A. industrial heating committee. Since then it has been exhibited at a number of other meetings and the film has already gained for itself an international reputation. Requests have been received from England and other European countries for prints of the picture.

The film is now complete and Walter H. Sammis, chairman of the N.E.L.A. national electric heating committee, has arranged schedules whereby positive prints can be purchased outright or it can be rented by power companies for a limited number of showings.

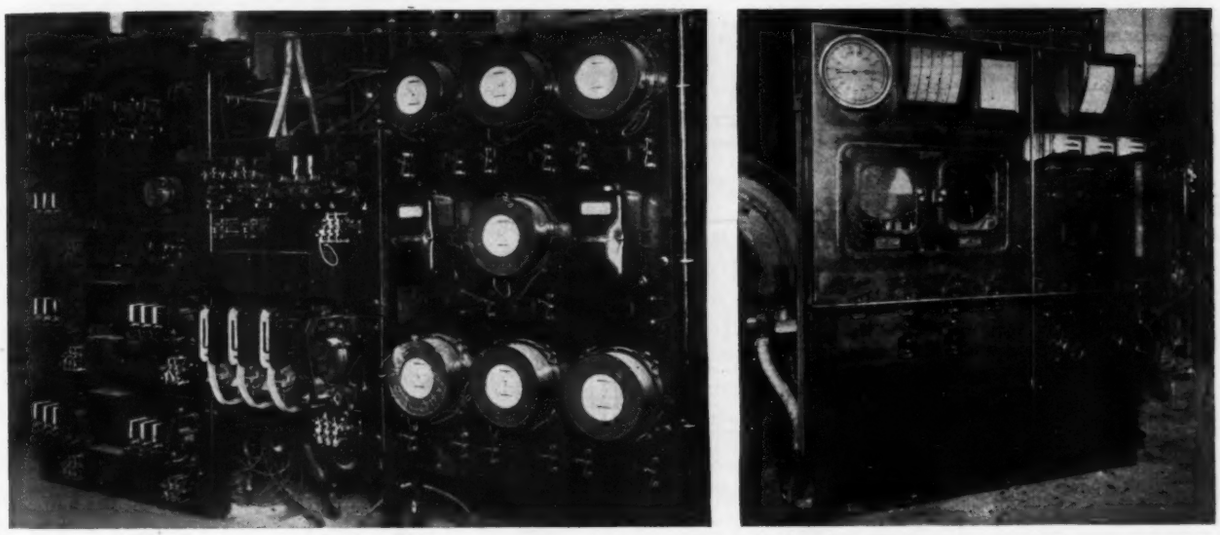
Proceeds obtained from the sale and rental of the film will be used in part to pay for the cost of its production and in part to keep the picture up to date by the addition of views of new applications as they are made from time to time. From expressions of opinions of those who have seen the picture it will prove a highly valuable means of promoting electric heating, and there are already a number of requests for showings before industrial and engineering organizations. In addition the film has been very useful in showing power company employees the extent of development of this class of load.

Control of Boiler Auxiliaries

Nature of operations that had to be controlled in running pulverized-coal-fired, water-walled, well-type furnaces at Buffalo and type of signaling and interlocking adopted

By W. S. MARTYN

Junior Engineer Buffalo General Electric Company, Buffalo, N. Y.



Control equipment for boilers in River station and heating station of Buffalo General Electric Company

IT WAS with the thought in mind that the Charles R. Huntley steam plant of the Buffalo General Electric Company was to function mostly as a stand-by station that pulverized-coal-fired boiler equipment was bought.

The steam-generating equipment consists of four B. & W. cross-drum boilers, each containing 12,515 sq.ft. of heating surface, not counting the 7,100 sq.ft. in the integral superheater. This lies between the horizontal circulators and the main bank of tubes, so that the headers form a part of the third-pass baffle. The furnaces are of the Fuller-Lehigh well type, inclosed on all four sides by water walls covered with Bailey alundum blocks, which add an additional 2,044 sq.ft. of heating surface. Each well is 15 ft. 7 in. square below the burner line, but the two side walls fall away above the burners so that the furnace above this line is 24 ft. 3 in. x 15 ft. 7 inches.

The fuel-burning equipment takes coal from the green coal bunkers, located above the main boiler room aisle, through two 20-in. conductor pipes to a Richardson automatic scale, whence it empties into a small receiving bin. This bin serves the double purpose of regulating the flow of coal from the scales and holding a slight reserve to protect against minor scale troubles. From here the coal is fed to each of the two mills serving the individual boilers by two drag-chain feeders. The mills are of the vertical, air-separation, ball type, so designed that the induced stream of air rises over the grinding zone, carrying the pulverized coal along in suspension. This mixture passes through the exhauster and is then introduced into the furnace through two Calumet burners.

There are four burners per furnace, one in each furnace wall. The four flames impinge upon one another, augmenting the turbulence produced by the method of introducing the secondary air through ports at both sides of the burners. Such turbulence gives rapid combustion, which is completed well below the boiler tube bank. The gases, after three passes through the boiler, are led through a Foster economizer having 9,600 sq.ft. of surface and then discharged to the stack by a double inlet Sturtevant fan.

While it was conceded that small turbines would meet the requirements of the boiler auxiliaries, afford a comparatively wide speed range and develop a smooth speed curve, they were passed up in favor of electric motors because of the complications of piping, control, etc., and the difficulty of maintaining a heat balance.

It was deemed best to standardize on induction motors for auxiliary drives on account of the complexity which would arise were part of the plant's auxiliaries on the alternating-current system and part on direct current. For the same reason and because of the greater cost of high-voltage equipment an extension of the 440-volt distribution system was made. The rule to keep everything alternating current was adhered to with one exception. That was the drive for the drag-chain feeders controlling the flow of coal to each of the pulverizing mills. Motors rated at 1½ hp. were required and it is necessary that they have at least a three-to-one speed range. Inasmuch

as the power demand was small the easiest solution was to install a small motor-generator set large enough to supply direct-current motors.

All motors with the exception of those driving the mill feeders are wound for 440-volt, three-phase, 25,-cycle current. All squirrel-cage motors are designed for "across-the-line" starting.

Maximum flexibility of control had to be obtained without impairing the reliability of operation by the use of excessive delicate automatic paraphernalia. Interlocking of operation was considered necessary to assure proper handling of the pulverized coal.

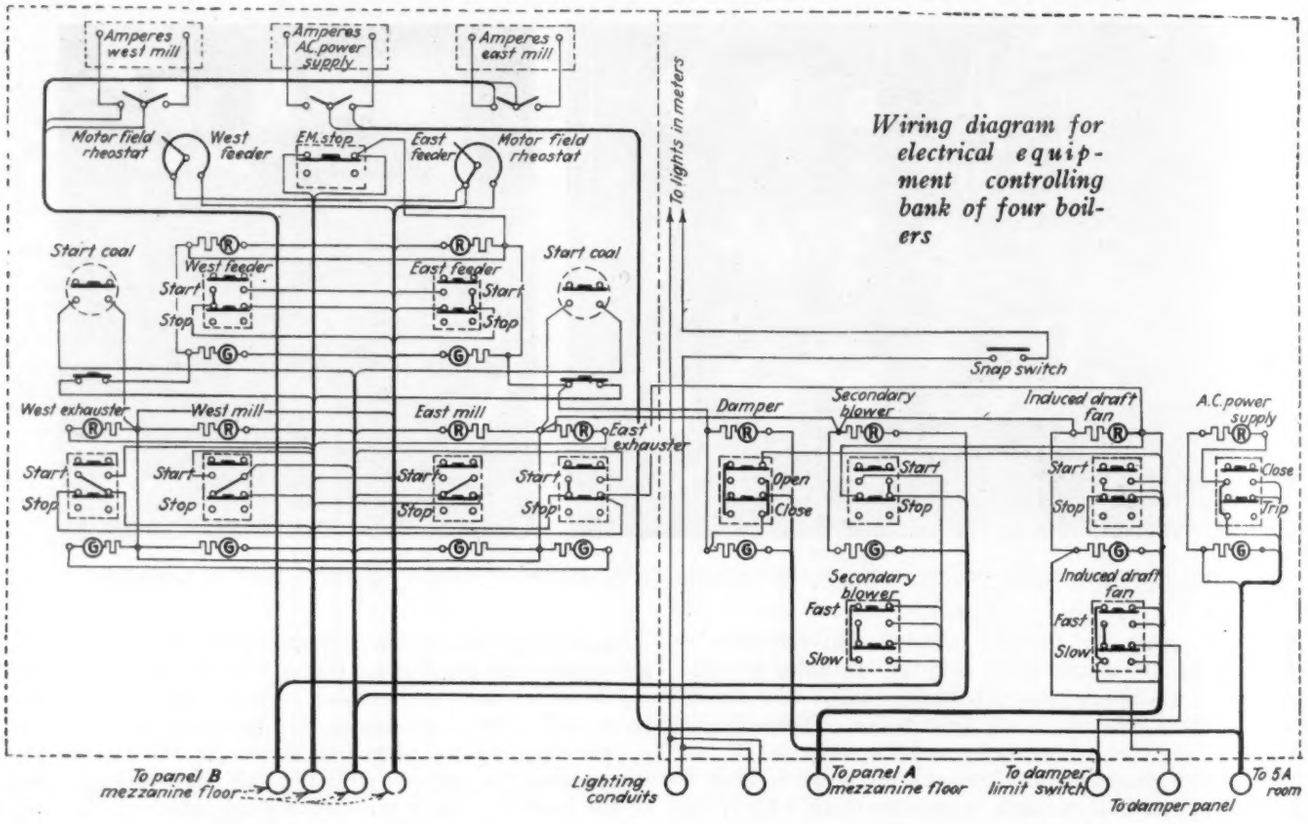
It is imperative that the induced draft fan be in service before any attempt is made to start the blowers, lest the furnace be put under pressure, forcing an explosive mixture out into the boiler room. After the induced-draft fan has been put in operation the secondary blower can be started, or if it is desirable to run at low ratings when all of the air is supplied by the exhausters, the latter are started, for it is not necessary to have the secondary blower going to start the exhausters. Furthermore, only one exhauster need be operating. The mills can now be started. As with the exhausters, only one mill need be run, but it can only be the one whose exhauster is in motion. The feeder is the last piece of apparatus that can be thrown in and, of course, only the feeder of the mill that is rolling can be started. Between the damper at the induced-draft fan inlet and the induced-draft fan is an interlock, arranged so that it is impossible to increase the speed of the fan unless the damper is in the wide-open position. The object of this is to prevent the operator from using needless power to produce the necessary suction when he might obtain that draft by opening the damper. The reverse operation is interlocked in the same way. In case of failure of any one auxiliary, those preceding drop out of service.

There is a special condition in which the sequence mentioned is not followed. When the coal is wet and the fires are being lighted for the first time it has been found that the wet coal ignites quicker if the mixture of coal and air going to the furnace is a very rich one. The easiest way to accomplish this is to have the mill grinding before starting the exhauster, so that when the latter is started the grinding ring will contain a large amount of very fine coal and the first rush of primary air will carry a heavy charge of coal into the furnace. The normal sequence is automatically re-established immediately after starting so as to maintain full protection.

The control of all the apparatus is centered at the boiler panel. Besides carrying the push-button stations, this panel supports pressure gages, boiler meters, draft gages, CO_2 meter, etc., necessary for the operator's complete information. The contactor panels, resistors, controllers, temperature and low-voltage relays, watt-hour meters, etc., with the exception of the resistors and controller for the induced-draft fans, are all mounted on a mezzanine floor almost directly beneath the boiler panels. Fan controllers are motor driven. Motor-driven controllers were not used on the mills because they were so situated that a mechanical control could be very easily arranged.

The induced-draft fan, located on the economizer floor above the boiler room, is driven from either end of the shaft. On one end is a 75-hp., 375-r.p.m., squirrel-cage motor and at the other a 400-hp., wound-rotor, slip-ring motor whose synchronous speed is 750 r.p.m. The speed range is divided into fourteen intervals, the lowest speed being full-load speed on the squirrel-cage motor and the highest the full-load speed on the 400-hp. motor. In starting up it is only necessary for the operator to press the "start" button located on the boiler panel, thereby placing the smaller motor across the line. Increasing

Wiring diagram for electrical equipment controlling bank of four boilers



the speed is done by pressing the "fast" button, having first, of course, opened the damper to the wide-open position. This operation opens the contactors of the 75-hp. motor and puts the 400-hp. motor on the line with all the resistance in the rotor circuit. The "fast and slow" button is nothing more than a reversing switch that operates the pilot motor on the controller. This motor is equipped with a solenoid brake to avoid overtravel, while undertravel is prevented by additional copper segments, placed at the top of the drum, with connections from the "fast and slow" switch through a holding coil and the damper limit switch to the pilot motor.

The controller and control for the secondary blower motor is identical with that used on the induced-draft fan drive with the exception that it handles but one slip-ring motor rated at 100 hp. at its full load speed of 720 r.p.m. The speed range is two to one and is accomplished in thirteen steps. The exhausters are driven by 60-hp. squirrel-cage motors. A General Electric magnetic contactor operated by a push button, mounted on the turbine panel, comprises the control.

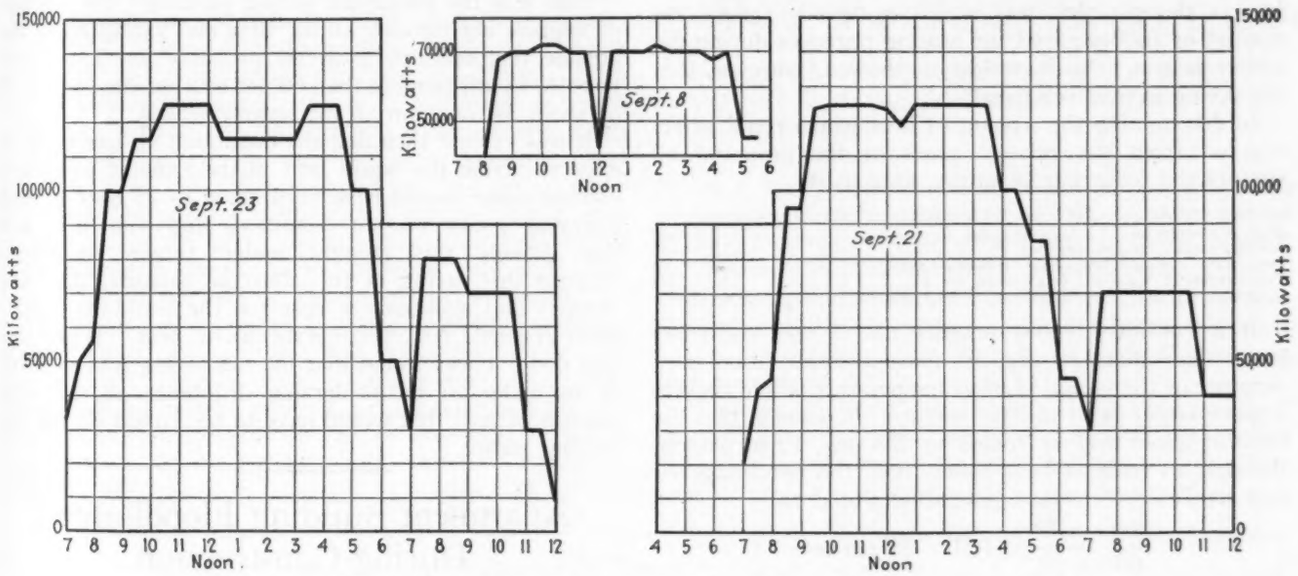
The mill motors are slip-ring induction, having a continuous rating of 125 hp. at 360 r.p.m. The speed ratio is two to one and the controller, like the others, provides thirteen steps.

The feeder motors, which are rated at 1½ hp., have a speed range from 1,800 r.p.m. (full-load speed) to 600 r.p.m., which is provided by a Ward-Leonard resistor placed in the shunt field of the motor. Thirty-three equal speed steps are thus provided.

Each feeder motor control is augmented by a signal system consisting of a light placed at the mill fed by the feeder, a gong located on the mill floor, a lockout switch situated at each feeder and necessary relays. This is done to enable the boiler operator to notify the mill man when one of the feeders is out and to designate which feeder it is. By pressing the signal button the operator causes the gong to ring and the light to appear at the troublesome feeder. The mill man upon arriving at the feeder opens the lockout switch, thereby stopping the gong (so that it may sound the alarm again if another feeder goes wrong) and extinguishing the signal light at the mill. He also puts out the indicating lamps on the panelboard which show whether the feeder is "in" or "out." When he has cleared up the trouble he closes the lockout switch and in so doing causes the "green" indicating lamp on the panelboard to light, telling the boiler operator that all is O.K. and the feeder may be restarted.

The damper control is a reversing switch connected through limit switches which prevent the motor operating after the damper has reached full-open or full-closed position. The damper-driving motor is a 1½-hp. squirrel-cage unit. This motor, like all the others, is equipped with a thermal overload relay.

The results of operation have been most gratifying. It is so simple to light a fire in the boiler and put it on the line that during some days of widely fluctuating load the boilers are often started up and shut down several times. The three charts, together with the boiler operator's log shown here, give a very good idea of how the boilers are operated. The charts are all from No. 15 boiler, tests on which were described in *Power*, issue of Nov. 22, 1927.



Wide fluctuations in power demands occur at Huntley station over period of day (Sept. 8, 21 and 23, 1927)

BOILER OPERATOR'S LOG FOR THREE DAYS

Sept. 8		
	8:00 a.m.	Lighted fire (drum pressure 100 lb.)
	8:10	On line
	11:50	Shutdown (load dropping)
	12:20 p.m.	Burners relighted
	12:25	On line
	4:48	Shutdown (load dropping)
	5:05	Off line
Sept. 21		
	7:45 a.m.	Lighted fire (drum pressure 120 lb.)
	7:50	On line
	9:27	Boosted rating (cleaning stoker fires)
	9:55	Dropped rating (fires cleaned)
	3:05 p.m.	Increased rating
	5:07	Dropped rating (load dropping)
	5:40	Shutdown (station dropped 45,000 kw.)
	7:25	Lighted fire (station picked up 40,000 kw.)
	7:30	On line
	10:40	Shutdown (load dropping)
	11:00	Off line
Sept. 23		
	7:25 a.m.	Lighted fire (drum pressure 195 lb.)
	7:26	On line
	12:00 p.m.	Increased rating (cleaning stoker fires)
	3:45	Dropped rating (load dropping)
	6:40	Shutdown (station dropped 50,000 kw.)
	7:15	Lighted fire (station picked up 50,000 kw.)
	7:20	On line
	9:40	Shutdown (load dropping)
	9:50	Off line

Finds Exhaust Gases Impracticable for Heating

By H. C. Thuerk
Manager Erie Lighting Company, Erie, Pa.

ONE of the power customers of the Associated System recently investigated the possibility of installing a small power plant and generating instead of purchasing power. Careful study of both steam and Diesel-engine-driven plants showed that it would be more economical for the industrial customer who was enlarging his manufacturing facilities to continue the purchase of energy to meet additional requirements.

Among the arguments advanced for the installation of the Diesel-engine plant was the utilization of the heat units in the exhaust gases and in the jacket cooling water. It was thought that this would materially reduce the amount of fuel required for heating purposes during the winter season. An investigation showed, however, that the saving is relatively small.

In determining the amount of heat which could be recovered from the exhaust gases of the proposed oil engines the following quantities were used:

Average temperature of exhaust gas, deg. F.	600
Average outside temperature, deg. F.	50
Percentage of original heat of fuel in exhaust gases	30
Temperature of steam at 5 lb. pressure, deg. F.	228

It is considered good practice not to cool the gases lower than about 50 deg. F. above the saturation temperature of the steam. Lower temperature would require a much larger heat transfer surface. Assuming that the exhaust gases may be cooled to 278 deg. F. in passing through an exhaust heat boiler, then the percentage of heat available for steam generation would be

$$\frac{600 - 278}{600 - 50} \times 100 = 59 \text{ per cent}$$

Since 30 per cent of the original heat in the fuel is contained in the exhaust gases, then the proportion of the original heat of the fuel which is available for steam generation will be 30 × .59 or 18 per cent.

The following table shows the amount of steam which would be generated under both present and future load conditions of the plant by utilizing this waste heat:

	Present Load	Future Load
Kilowatt-hours generated per month	40,000	80,000
Fuel used in gallons	4,000	8,000
Heat units in fuel at 18,500 B.t.u. per pound	555,000,000	1,100,000,000
Heat units available for steam generation	100,000,000	200,000,000
Pounds of steam generated at 70 per cent boiler efficiency, feed water temperature 130 deg. F.	66,600	133,200
Pounds of steam available for seven months	466,200	932,400
Tons of coal saved at 6 lb. evaporation	39	78

It was problematical as to how much of the heat in the cooling water could be utilized. This water might be used for boiler feed water during the time the engines were in operation, but since the returns from the heating system would also be utilized for boiler feed it was apparent that cooling water could be used only to supply the losses in the heating system and additional make-up water.

It would have been possible to install a small amount of hot water radiation and return the jacket cooling water through this system. However, an auxiliary supply of hot water would be required when the engines were not running, which fact made this plan not so simple as it appeared.

If the cooling water were passed through a small hot water system the maximum saving in fuel would be computed in the following manner. If the outlet temperature of the cooling water is 130 deg. and the inside temperature of the building is 70 deg., then the heat available for heating would be

$$\frac{130 - 70}{130 - 32} \times 100 = 61 \text{ per cent}$$

Assuming that 30 per cent of the original heat in the fuel is contained in the cooling water, then the total heat which could be utilized each month is

$555{,}000{,}000 \times 0.30 \times 30 \times 0.61 = 100{,}650{,}000$ B.t.u.

The coal saved during seven months would have been

$$\frac{100{,}650{,}000}{1{,}050 \times 6 \times 2{,}000} \times 7 = 56 \text{ tons}$$

This was the maximum saving possible. On account of engines not running all the time and variations in the outside temperature, it would probably not have been possible to utilize more than 60 per cent, or the equivalent of about 34 tons, during the heating season.

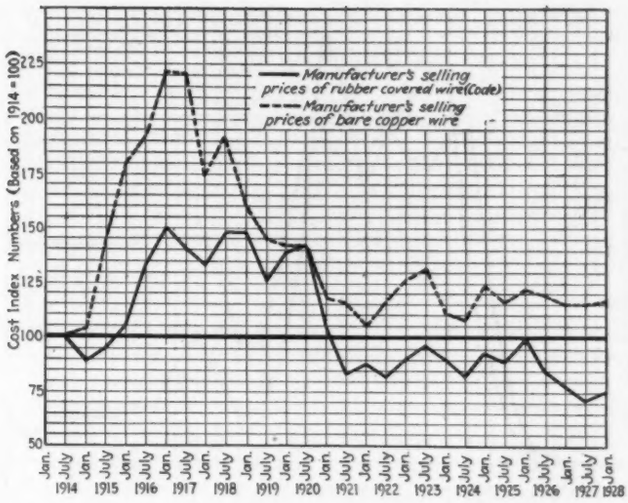
It was evident then that the maximum utilization to be expected from the waste heat in the exhaust gases and cooling water would have been equal to 73 tons of coal per year under present conditions and something less than double this amount under future conditions. Against this saving in fuel must be balanced the fixed charges and maintenance costs on the additional equipment required for utilizing the waste heat. When this was done, it was found that the net saving was so small as to make an inconsiderable difference in the total amount of coal that would have to be burned during the heating season.

Apartment Building Floodlighted During Construction

A NEW use for floodlighting is developing in Seattle, Wash., to establish the location of a building under construction. It is worthy of wider application. The accompanying illustration shows the Marlborough apartments floodlighted with fourteen 1,000-watt units placed on nearby light poles. The building, thus brilliantly illuminated, attracted attention for some distance and was well fixed in the public mind by the time it was completed.

Trend in Prices of Supplies

Prices virtually down to a pre-war basis. Items listed make up 60 per cent of average jobber's total sales

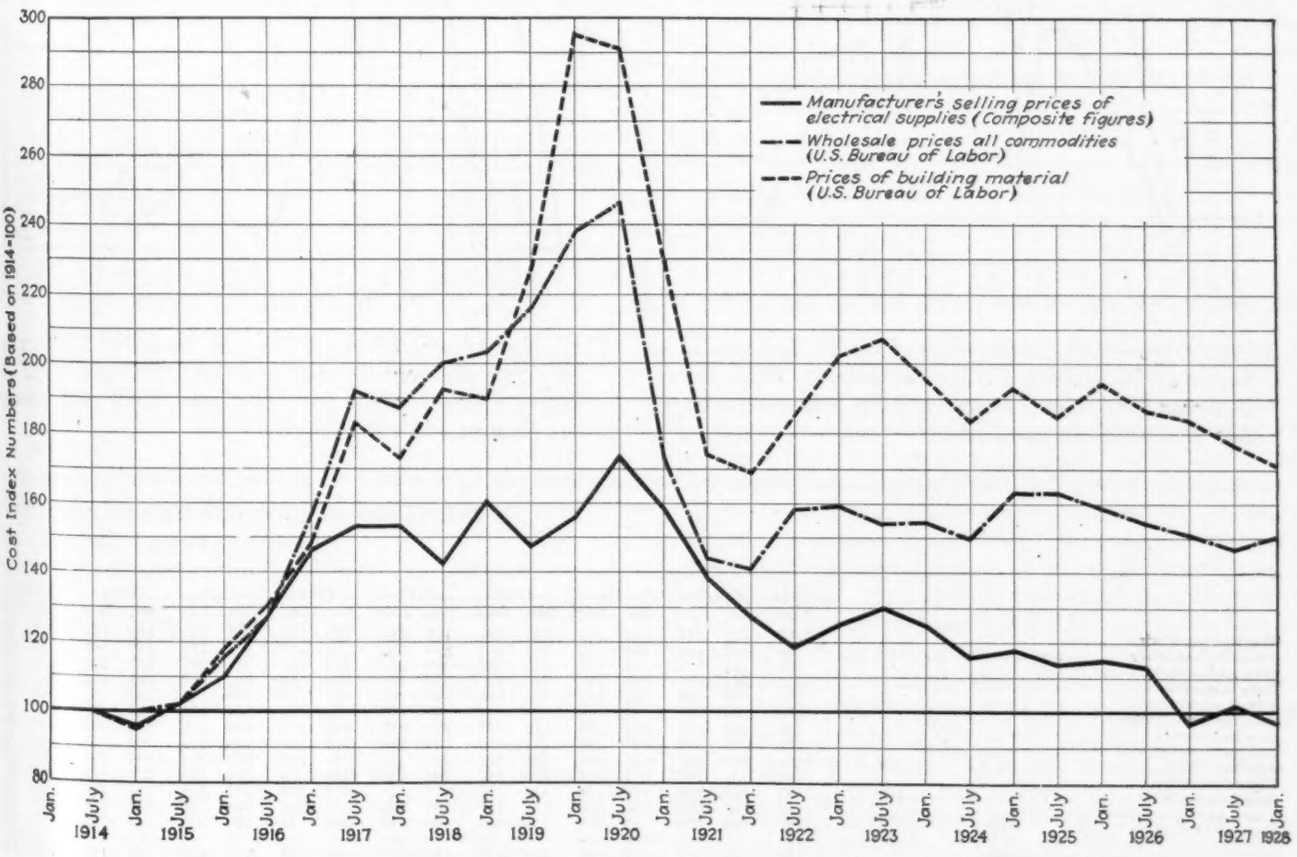

Manufacturer's selling prices of rubber covered wire (Code)
Manufacturer's selling prices of bare copper wire
Cost Index Numbers (Based on 1914 = 100)
225
200
175
150
125
100
75
50
Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan.
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928

In July, 1927, the index price of rubber-covered code wire was 71, the lowest recorded. In January, 1928, the index was 75

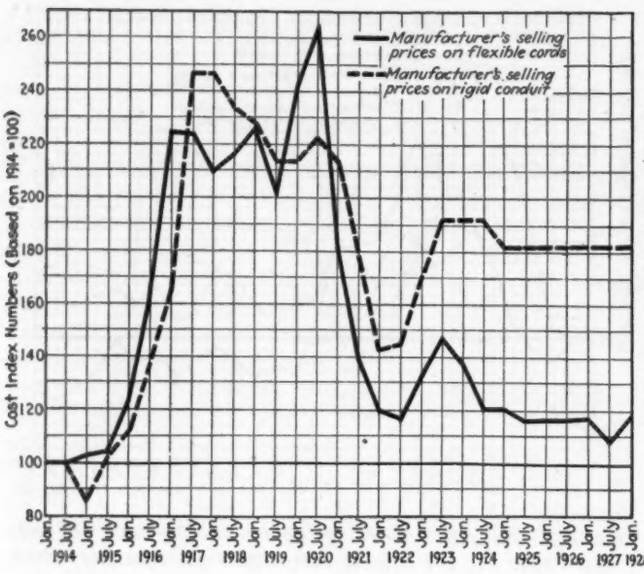
PRICE indexes of electrical materials, originally presented in the Feb. 16, 1924, issue of the ELECTRICAL WORLD, to include figures for January, 1928, are given in the accompanying table and graphs. The figures given cover manufacturers' selling prices of representative electrical commodities and were obtained from a fully authoritative source. The information is given in the form of index figures based on 1914 prices, making it possible to arrive at the manufacturers' selling price of any one of the items for any date since 1914 if the price is known for any period between 1914 and 1926. The prices are the average for the months as shown.

The index has continued to decline and the composite index number now indicates that the prices of electrical supplies are virtually down to a pre-war basis. The figures are, of course, national in character and are not influenced by local conditions which may exist or which may have existed during the period covered. The index numbers are, generally speaking, a comparison of the prices of unit quantities of a typical size, type or design of an item in each particular line representative of the whole. The index numbers, therefore, are quite accurate in showing the price movement in such items as wire, batteries, rigid conduit, tapes and compounds and standard porcelain, but there has been some difficulty in getting a true index of items that have shown marked changes in type and design during the period.

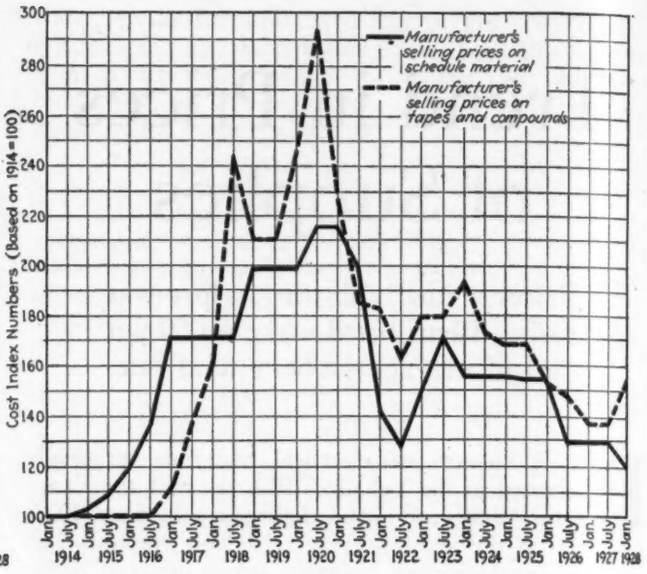
While all the items entering into the general group of commodities known as "electrical supplies" are not included in the accompanying table and diagrams the thirteen items for which data are given cover a large per-


Manufacturer's selling prices of electrical supplies (Composite figures)
Wholesale prices all commodities (U.S. Bureau of Labor)
Prices of building material (U.S. Bureau of Labor)
Cost Index Numbers (Based on 1914 = 100)
300
280
260
240
220
200
180
160
140
120
100
80
Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan.
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928

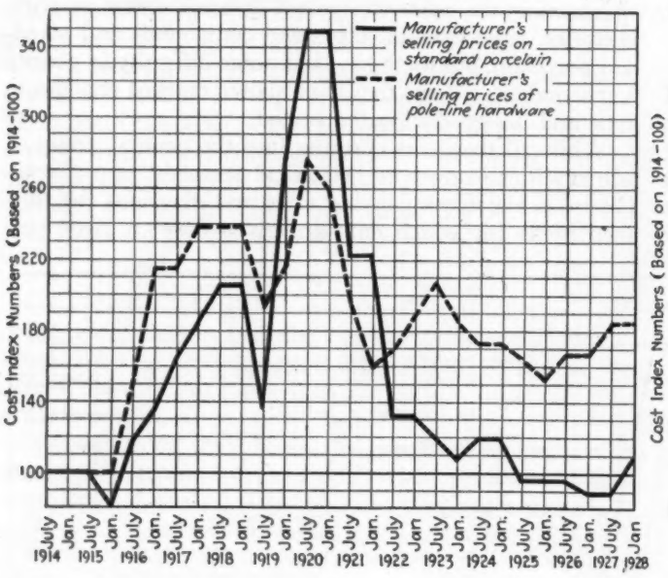
Comparative price indexes of electrical material, all commodities and building material


Manufacturer's selling prices on flexible cords
Manufacturer's selling prices on rigid conduit
Cost Index Numbers (Based on 1914 = 100)

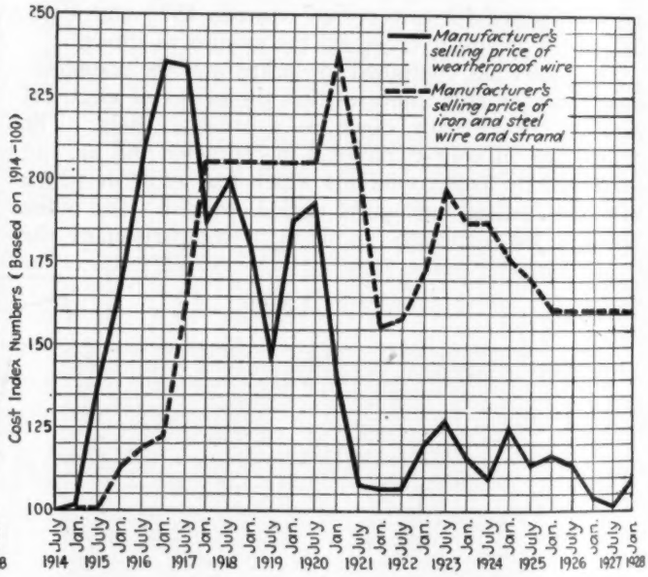
Prices of flexible cords and rigid conduit more than doubled from 1917 to 1921. Since 1924 the index for flexible cords has been around 120 and since 1925 rigid conduit has held at 182


Manufacturer's selling prices on schedule material
Manufacturer's selling prices on tapes and compounds
Cost Index Numbers (Based on 1914 = 100)

Both tapes and compounds and schedule material have registered declining prices in the last three years. In January, 1928, the index for tapes and compounds increased to 154


Manufacturer's selling prices on standard porcelain
Manufacturer's selling prices of pole-line hardware
Cost Index Numbers (Based on 1914 = 100)

Standard porcelain prices show a steady decrease to an index of 98 in July, 1927. In January, 1928, the index was 109. Since January, 1926, pole line hardware has gradually increased to 185

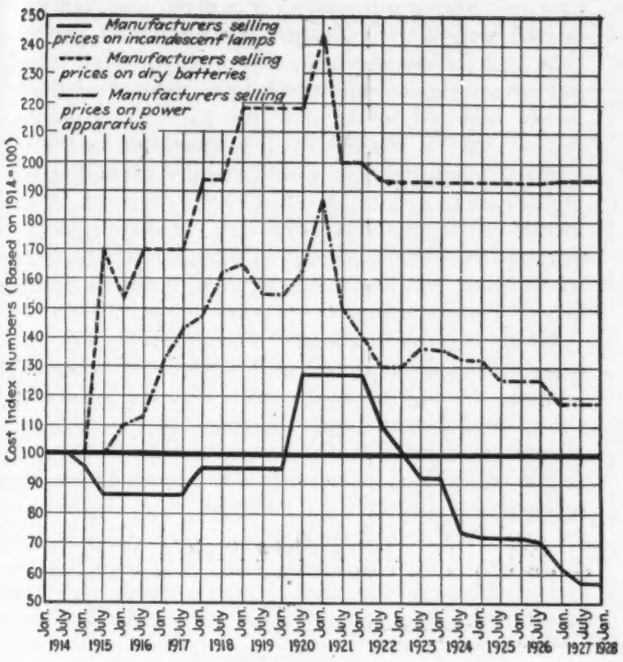

Manufacturer's selling price of weatherproof wire
Manufacturer's selling price of iron and steel wire and strand
Cost Index Numbers (Based on 1914 = 100)

The price of weatherproof wire in January, 1928, was only 109 per cent of that in 1914. In July, 1927, it nearly reached par. Iron and steel wire and strand has been at 161 since 1926

Price Index of Electrical Materials at Manufacturer

(Based on 1914 Prices = 100)

	1914 Year	1915 Jan.	1915 July	1916 Jan.	1916 July	1917 Jan.	1917 July	1918 Jan.	1918 July	1919 Jan.	1919 July	1920 Jan.	1920 July	1921 Jan.	1921 July	1922 Jan.	1922 July	1923 Jan.	Jul
Weatherproof wire	100	102	137	168	207	235	234	187	200	180	147	187	193	140	108	107	107	120	
Pole-line hardware	100	100	100	100	151	215	215	239	239	239	194	217	275	259	195	161	170	190	
Iron and steel wire and strand	100	101	101	112	118	122	163	205	205	205	205	205	205	237	202	156	158	172	
Bare copper wire	100	104	145	180	193	222	221	175	193	160	145	142	142	118	116	105	116	127	
Power apparatus	100	100	100	110	113	131	144	148	163	165	155	155	163	188	151	142	130	130	
Incandescent lamps	100	95	86	86	86	86	86	95	95	95	95	95	127	127	127	127	111	101	
Dry batteries	100	100	170	153	170	170	170	194	218	194	218	218	218	243	200	200	194	194	
Rubber-covered wire (code)	100	89	95	105	133	151	140	133	148	148	127	139	142	105	84	88	82	90	
Flexible cords	100	103	104	123	164	225	224	210	216	226	202	241	262	182	139	120	117	133	
Rigid conduit	100	86	102	112	137	165	247	247	234	229	214	214	223	214	179	143	145	170	
Schedule material	100	103	108	119	136	171	171	171	171	199	199	199	216	216	199	142	128	150	
Tapes and compounds	100	100	100	100	100	111	137	161	243	211	211	246	292	228	186	183	163	180	
Standard porcelain	100	100	100	80	118	136	165	185	206	206	139	278	348	348	222	222	133	133	
Electrical supplies (composite figure)	100	96	102	110	127	146	153	153	142	160	147	155	173	159	139	128	119	125	



In January, 1928, incandescent lamp prices were only 57 per cent of the 1914 price

centage of the electrical supplies manufactured. A somewhat higher composite index number would be obtained if more items were included, but it is estimated that the items listed comprise about 60 per cent of the average jobber's total sales. The figure given is a physical volume index and the individual indexes are weighted by the volume of sales for each item. Incandescent lamps weight the index heavily in the winter months and this item, together with rubber-covered and weatherproof wire, operated strongly to bring the index down to the pre-war level. The price of wire varies considerably in the various classes. Weatherproof wire follows very closely the prices of bare copper wire.

The extent to which the prices of electrical supplies as a whole have been held down by manufacturers since 1914, as compared with the wholesale prices of commodities and the high prices asked for building materials, is clearly shown in an accompanying illustration. During the peak year 1920 the increase in the price of electrical supplies was considerably less than that of all commodities or building material. In January, 1928, the composite figure for electrical supplies was 97, compared with 150 for all commodities and 171 for building material

Selling Prices

1924 Jan.	1924 July	1925 Jan.	1925 July	1926 Jan.	1926 July	1927 Jan.	1927 July	1928 Jan.	
116	110	124	114	117	114	104	102	109	Weatherproof wire
185	173	173	164	153	167	167	185	185	Pole-line hardware
187	187	176	170	161	161	161	161	161	Iron and steel wire and strand
111	108	124	116	121	120	115	115	116	Bare copper wire
136	133	133	126	126	126	118	118	118	Power apparatus
92	74	72	72	72	71	62	57	57	Incandescent lamps
194	194	194	194	194	194	194	194	194	Dry batteries
90	82	93	89	99	85	78	71	75	Rubber-covered wire (code)
138	121	121	117	117	117	117	108	118	Flexible cords
192	192	182	182	182	182	182	182	182	Rigid conduit
156	156	156	155	155	129	129	129	120	Schedule material
194	174	169	169	154	149	137	137	154	Tapes and compounds
108	120	120	97	97	97	89	89	109	Standard porcelain
125	116	118	114	115	113	97	102	97	Electrical supplies (composite figure)

Ten Months' Sale of Electrical Farm Equipment

THAT the central-station company has a strong influence and responsibility in developing the use of electrical equipment by farm customers is shown in the results which have been attained by the Ohio Public Service Company, Elyria, Ohio, through its work in conjunction with a local farm implement dealer. As outlined on page 817 of the ELECTRICAL WORLD, April 16, 1927, the Ohio Public Service Company arranged an extensive permanent display of electrical farm equipment in the store of the Farm Implement Company in Elyria. This was followed by a series of demonstrations and the rural lines representatives of the power company invited existing and prospective farm customers to visit the display and inspect the equipment in operation. Many sales to rural customers have resulted and in the first full year's operation of this display more than $30,000 of electrical equipment has been sold. An itemized list of the apparatus sold during the first ten months is given here.

FARM EQUIPMENT SOLD IN TEN MONTHS OF DISPLAY UNDER SPONSORSHIP OF OHIO PUBLIC SERVICE COMPANY

No.	Equipment	Value	No.	Equipment	Value
78	Electric water systems	$8,461.00	22	Corn poppers	$54.00
10	Electric milking machines	432.00	26	Curling irons	45.00
2	Cream separators	304.00	2	Heaters	35.00
6	Electric brooders	90.00	8	Fans	40.00
66	Electric washing machines	10,080.00	25	Hotplates	75.00
2	Ventilating fans	70.00	18	Coffee percolators	147.00
17	Vacuum cleaners	551.00	2	Large feed grinders	250.00
60	Flatirons	325.00	2	Chicken feed grinders	45.00
55	Toasters	185.00	4	Large irrigation systems	8,200.00
20	Waffle irons	130.50	1	Electric ½-hp. motor	129.00
			1	Electric drill and saw set	35.00
			20	Christmas tree light sets	40.00

Commenting on these results, J. B. Johnson, district manager of the Ohio Public Service Company, said: "This is a formidable list, but it is a very small percentage of even a fair saturation and represents only a small part of the business that can be developed. It represents the results from only one effort in one county in Ohio, but it tends to indicate what can be accomplished when a workable contact is established by the central-station company with rural customers and the farm implement dealer."

"D.R." Plan Sells Many Appliances

THROUGH the courtesy of Stone & Webster, Inc., manager of the Electric Light & Power Company of Abington & Rockland, Mass., the results of the district representative plan of customer contact pioneered on that property are now available for 1927. Each district representative serves about 800 residential customers in an assigned territory, reading meters, attending to service matters, adjusting complaints, selling appliances and in general giving the company a living personality in his neighborhood. During 1927 the nine district representatives of the company sold $99,777 worth of electrical appliances, or an average of about $11,000 per man. The company serves a large rural territory interspersed with small towns, and its total sales of appliances in its own store were $6,628 for the year. Lamps are included in the foregoing figures. The maximum and minimum appliance sales per "D.R." were $20,453 and $6,464 respectively. These appliances add an annual energy consumption of about 391,550 kw.-hr. to the company's business. The average appliance purchases per residence customer for the year, including lamps, was $18.42. The

gross profits on the appliances sold more than covered the labor of the district representatives, including meter reading and servicing. About 40 per cent of the time of these men was expended on merchandise sales during the year. In 1926 the total sales were $99,169.

Letters from Our Readers

Norway Claims 2,400 Kw.-Hr. per Capita

To the Editor of the ELECTRICAL WORLD:

I have seen with interest the statistics of the electrical industry given in the Jan. 7, 1928, issue of the ELECTRICAL WORLD and shall be glad if you will help me correct an error in the statistics.

In one of the graphic tables on page 34 it is stated by your statistician that the generated electrical energy in Norway in 1925 was only about 220 kw.-hr. per capita. We are proud that we are living in one of the best, if not the best, electrified countries in the world, and in 1925 our energy consumption was about 6,700,000,000 kw.-hr., or 2,400 kw.-hr. per capita. Twenty-five per cent of the energy was used for public utility purposes. With these figures we beat even the state of Montana, which, according to the table on page 60, had 2,020 kw.-hr. per capita (in 1927?) and is the leading state of the U. S. A.

In this connection it would be interesting to know whether the total production of energy in Montana is consumed in that state or whether a certain part of the energy is exported to other states. TRYGVE HODNE.

[The figures on which the chart in the Jan. 7 issue was based were subsequently published in the ELECTRICAL WORLD, Feb. 11, 1928, together with the source of the information. The output was there given as 6,200,000,000 kw.-hr., or 2,270 kw.-hr. per capita, which figure should be used instead of that shown on the chart. The slight discrepancy between this 2,270 and 2,400 kw.-hr. quoted by Mr. Hodne (mailed Feb. 14) is apparently due to differences in information coming presumably from official sources.—EDITOR.]

Improvements in Turbo-Generators and Speculations Upon Them

To the Editor of the ELECTRICAL WORLD:

The editorial appearing on page 441 of the March 5 issue of ELECTRICAL WORLD entitled "Improvements in Turbo-Generators and Speculations Upon Them" is very interesting and brings out one point in particular that I have been interested in for some years, although I have never had an opportunity of doing anything in this line, namely, the use of a refrigerant in connection with such units. In view of the very wide application of mechanical refrigeration to industry, which includes its use in many specialized manufacturing operations, it would seem that there should be no insurmountable difficulties in adapting refrigeration to turbo-generator design. The cooling and conditioning of air by means of mechanical refrigeration has been a reality for years, as has been the case in the cooling of other gases.

In turbo-alternators, where hydrogen gas is used as the cooling agent, such gas could be cooled through any desired range and its temperature automatically controlled within very close limits. All that the refrigerating engineer would need to know to calculate the necessary refrigerating tonnage for a given installation would be the weight of hydrogen gas circulated per unit of time and its specific heat, the range through which the gas is to be cooled and the heat equivalent of the horsepower required to circulate the gas. It is obvious, of course, that a scheme of this character could not be adopted overnight, but would require careful study and investigation, and no doubt a certain amount of experimental work would be necessary. However, any practical and economical means of maintaining the generator windings at the lower temperature levels is well worth serious consideration.

By the use of mechanical refrigeration, any practical heat head or temperature difference could be maintained between the highest temperatures of the generator and the cooling medium, with the result that large quantities of heat could be taken up.

The amount of power actually required to operate a refrigerating machine of sufficient capacity to produce the necessary cooling would be a very small percentage of the total auxiliary power required by turbo-generators and would unquestionably be an excellent return on the investment. C. T. BAKER.

Atlanta, Ga.

Let the Seller Profit

To the Editor of the ELECTRICAL WORLD:

In commenting upon the articles you have been publishing on the subject of price cutting, there is no question in my mind that it is good policy to follow the lead of the leading automobile concern that recently was reported to have given instructions to its buying department that it must cease "hard buying" and pay a price fair to the manufacturer as well as to itself. In a recent article in the New York *Times* I made the following statement, which is to the point:

> There are, however, many other angles to the buying of merchandise that need to be considered in this general question. It is obvious that if buying were to be confined to paying the "first price" offered there would be no need of a purchasing agent.
>
> The purchasing agent is an officer of the corporation, and as such he views a purchase from general market conditions rather than as a single transaction. He has to watch the market to be sure he is not overpaying and that concerns which compete with his own are not able to buy more cheaply. He naturally is trying to get a little better quality at a price which is a little lower. And his success in this endeavor plays a large part in the success of the entire corporation.
>
> The buyer frequently has no reliable or entirely accurate information as to what the bottom price is on certain merchandise in which he is interested. Accordingly, in dealing with certain types of salesmen, the job of the purchasing agent is to smoke out the "confidential stuff." In every purchase, as I have said, he is guided by the relation of the price he is asked to pay to that paid or likely to be paid by his competitor.
>
> If a manufacturer finds himself with a big inventory and is forced to make concessions to get orders, no buyer is going to pay more than the prevailing market conditions warrant. This manufacturer speculated in covering his raw material requirements in advance, and if he did not gage the action of the market correctly that is his error.
>
> These considerations deal solely with market conditions and do not parallel the seeking of the "last drop of blood," of which sellers can rightly complain.
>
> There is every indication of a greater degree of co-operation and mutual understanding between buyers and sellers. In no way can this be fostered better than by the realization that a fair profit for both is essential.

W. L. CHANDLER,
Secretary and Treasurer.
National Association of Purchasing Agents.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Heating Trash Rack Bars Electrically.—C. R. REID.—In order to combat anchor or frazil ice, formed in turbulent open water in the forebay of a hydro station subject to extremely low temperatures, electrically heated trash rack bars were devised. The author reviews the installation and offers the empirical formulas utilized in developing this equipment. Performance details are included. It is stated that the best method of overcoming this ice trouble lies in the proper design of the hydraulic system above the rack bars, as a large body of quiet water will freeze over quickly and an ice covering of sufficient size will be formed to prevent the surface formation of heavy ice crystals. The ice needles either adhere to the under side of the ice covering or are remelted in the warmer water under the ice. If the velocity approach is low and the racks are set at a considerable depth, and if, in addition, the bed of the approach channel is smooth and grades down easily to the bottom of the racks or even considerably below that, frazil ice trouble should be entirely eliminated. However, when this is not possible other precautions must be taken. In the present installation a voltage of 126.5 and a current of 3,680 amp. are utilized, giving an input per cubic feet per second of 227 watts. It is stated that sufficient experience has been gained with this installation to demonstrate that just about the right amount of energy input has been provided. Severe frazil ice conditions have been handled with entire success at this plant on several occasions. The author concludes that electric heating of racks is of particular value in locations where frazil ice trouble develops quickly and is not of long duration. When such trouble is experienced more or less continuously it is suggested as being desirable to install rack bars made of tubing welded into headers and to circulate warm water through them as temperatures and conditions may require.—*Electrical News (Canada)*, March 15, 1928.

Heat Applications and Material Handling

Electric Heating and Load-Factor Improvement.—M. O. F., England.—As a result of an analysis and investigation of available mediums for the improvement of load-factor conditions the author has concluded that the desired results can be obtained by creating a load consisting of electrically heated water storage cylinders and controlling this load from the power house or substation by inexpensive means. It is said that under certain conditions the cost of supplying hot water in this way compares very favorably with coke fuel, especially with the smaller consumer. The larger consumer may pay a little more for his hot water, but the initial expense is small, and in other ways the electric system is ideal. The electrical equipment suggested for such installation consists of a simple form of remote relay control, while the operating voltage is so low that no danger is incurred, even if bare wires are run overhead on ordinary telephone poles and insulators. This discussion, of course, refers to possibilities following the practices involved in Great Britain. The containers must be properly insulated to prevent the diffusion of the stored heat.—*World Power (England)*, March, 1928.

Transmission, Substations and Distribution

Insulating Oils for High-Voltage Cables.—T. N. RILEY and T. R. SCOTT.—Oils suitable for high-voltage cables are in general equally suitable for low-voltage work, according to the authors, but many of the characteristics which are of importance for high voltages are of minor importance when the stress in the dielectric is low and the range of oils available is therefore increased. Chemically, there are said to be few fundamental requirements, since it is the physical and electrical properties which determine the most suitable compound. Physically, the compound must have the properties of a lubricant in order that the paper layers may slide over each other without fracture when the cable is handled. The viscosity must be sufficiently low at the processing temperature to permit thorough impregnation of the paper. On the other hand, it must be sufficiently high at service temperatures to prevent easy drainage when the cable is laid on a slope or when it is cut for splicing. The author reviews the necessary fundamental characteristics and presents determinations arrived at through exhaustive laboratory tests. It is concluded that the physical requirements severally mentioned are essential if a well-impregnated cable is to be constructed. It is shown that the power-factor-temperature characteristic of the oil is of importance, not only in relation to the actual value of dielectric losses exhibited by the cable, but also as an index of the state of chemical and physical stability of the oil. The elimination of gas pockets in the dielectric is of vital importance, not only for preventing burning and oil oxidization, but for obtaining low thermal resistivity.—*Electrician (England)*, March 9, 1928.

220-Kv. Lightning Arresters.—A. L. ATHERTON.—The use of lightning arresters on the terminal stations of the Conowingo-Plymouth Meeting line is of interest as it constitutes a departure from the previous general conception that lightning arresters are not needed for such service, or at least that they are not economically justified at 220 kv. and also because the arresters are said to be the largest in service. The study which preceded the decision to utilize this equipment has been outlined in this discussion to determine the benefits to be secured by such protection. Consideration was given to the insulation of the proposed line station yard and apparatus. Assumptions were made as to the most severe transient likely to occur on the line. The proper arrester was selected to suit the anticipated operating voltage of the station. From the characteristics of the arrester and line and from the station layout determinations were made of the voltage which will be applied to the station equipment when such a maximum transient arrives at the station. It was found that these voltages may be potentially dangerous, but that special choke coils will reduce and may be expected to eliminate this danger. As a result of this investigation, it is indicated that there are probably many other cases in which such a study would point out hazards both of yard flashover and apparatus damage which might be avoided by some relatively minor changes in the protection scheme.—*Electric Journal*, March, 1928.

Units, Measurements and Instruments

The Neon-Electric Stroboscope.—E. E. STEINERT.—The need for a stroboscope that could be used in the study of power system stability to measure, among other things, the various displacement angles caused by different load conditions has been met by the development of the neon-electric stroboscope. This device consists of four parts: A special transformer, a condenser, a neon lamp and a disk. The transformer, condenser and neon lamp are inclosed in a case for protecting the lamp against breakage and the operator against high voltage. The only electrical connections to the case are those leading to the transformer primary, which operates from a 110-volt, 60-cycle supply and the only technique required in its operation is to place the box where the light can fall upon the disk. No tuning or adjustments are necessary. As the investigators use the disk directly not through slots or past vibrating parts an element of considerable simplicity is introduced. The element which makes this stroboscope effective is the special transformer, the secondary voltage of which is characterized by a sharp, well-defined peak. The author states that the success with which the neon-electric stroboscope has been used in recent tests is a direct result of its high degree of accuracy, which is possible only because of the extreme clearness of the image. Other

features of this device are compact and rugged construction. It is said to be as portable as an ordinary voltmeter.—*General Electric Review*, March, 1928.

Symmetrical Components.—C. F. WAGNER and R. D. EVANS.—A brief review of the laws governing complex numbers precedes the development of certain theorems regarding the resolution of simple complex numbers into symmetrical groups. These developments apply largely to electrical systems involving symmetrical or balanced impedances. Illustrative examples of these theorems are offered in connection with specific examples, such as the analysis of short circuits in transmission networks. This is followed by the application to a few miscellaneous problems, some of which involve unsymmetrical impedances. The treatment is limited to three-phase systems, except that the last portion of the discussion develops some of the more important relations as applied to two- or four-phase systems. It is stated that a knowledge of the method of symmetrical components is essential for an adequate understanding of the application problems involving the magnitude and phase relation of voltages and currents under unbalanced conditions and is therefore necessary for the design of power stations from the standpoint of cricuit-breaker application, relay protection and stresses in electrical machinery. The method is particularly suitable for the analysis of the performance of rotating machinery for single-phase or unbalanced polyphase operation and has been used quite extensively in connection with the design of machinery on single-phase railway systems, particularly from the standpoint of phase-converting apparatus.—*Electric Journal*, March, 1928.

Electrophysics, Electrochemistry and Batteries

Thickness of Photo-Electrically Active Rubidium Films.—HERBERT E. IVES and A. L. JOHNSRUD.—The extreme tenuity of the layer responsible for photo-electric emission offers a possible answer to what has been a long-standing question with regard to selective and normal photo-electric emission. The question is stated by the authors to be, why does the emission under certain circumstances differ for a light polarized in and perpendicular to the plane of incidence, by a factor many times greater than the ratio of the optically measured absorptions? In the light of the experiments described in this article, it appears possible that the intrinsic absorption of the extreme surface layer may differ, for light polarized in the two planes, by a very large factor, but that the total optical absorption, which is due to a relatively considerable depth of material, may not exhibit this difference. A definite orientation of surface atoms, overlying atoms randomly disposed, could result in behavior of this sort. In any event, whatever the cause of the high selective-to-normal-emission ratio, it is clear, for the subject matter considered, that any close correlation of bulk optical properties with photo-electric properties is not necessarily to be expected.—*Reprint B-282, Bell Telephone Laboratories, Inc.*

The Deterioration of Lead Cable Sheathing by Cracking and Its Prevention.—S. BECKINSALE and H. WATERHOUSE.—The phenomenon of the cracking of lead cable sheathing received little attention by metallurgists until recently, according to the author, and has only been studied as a corollary to other forms of intercrystalline cracking, and, in particular, season-cracking. The results of the numerous and extensive researches into the causes and methods of prevention of season-cracking of brass and other metals appear, however, to be inapplicable to the case of cracking of lead. Because of the almost negligible elastic limit of the metal and its readiness to self-anneal at atmospheric temperature it is stated that a state of internal stress of sufficient magnitude to cause intercrystalline failure of the season-cracking type is improbable. The investigation covers microscopic and chemical determinations for suspended aërial cable, underground construction and other installations where such failures were found.—*Engineering* (*England*), March 9, 1928.

Telegraphy, Telephony, Radio and Signals

Economical Design of Loaded Telegraph Cables.—E. S. HEURTLEY.—The economical design of a cable of any given length and required transmitting speed is considered and it is shown that in general for equal performance a cable intermittently loaded is materially cheaper to manufacture than a cable loaded throughout. A brief outline of the methods employed in obtaining the results is given. The author includes a number of suggestions for reducing mechanical costs and suggests the possibility of duplex operation as a method of further minimizing expenses.—*Electrician* (*England*), March 9, 1928.

Experiments and Observations Concerning the Ionized Regions of the Atmosphere.—R. A. HEISING.—Experiments are described by the author in which a virtual height of the reflecting ionized region was measured, using time lag between impulses arriving over a direct and reflected path. Movements of the reflecting region are plotted, showing slow rises and rapid drops. Transmission measurement curves are given, showing dependence of meter signals upon night ionization and the assistance that sunlight ionization can give. Experiments and curves are mentioned that show absorption to be one of the important factors causing poor daylight transmission in the wave length region contiguous to 214 m. It is pointed out that the absorbing region is below the refracting region and that the sky wave must make two passages through the absorbing region. According to this theory the electromagnetic waves from the sun produce the ionization in the absorbing region and part of the day ionization in the refracting region. This ionization is pictured as beginning at an altitude of about 16 miles and extending upward, and as experiencing diurnal and seasonal variations.—*Reprint B-283, Bell Telephone Laboratories, Inc.*

Traction

The Operating Costs of Electric Industrial Trucks and Motors.—C. B. CROCKETT and H. J. PAYNE.—The authors have endeavored to show how direct and indirect costs of a materials-handling system may be classified and estimated and have applied the methods described to the question of operation of electric trucks. The direct costs of operation are here divided into fixed charges and operating charges, both of which are fully enumerated and where possible evaluated. Actual figures of cost of operation taken from several plants are presented and the savings due to truck operation pointed out. The various items entering into cost estimates have been defined in relation to the life of the trucks, battery, charging equipment, etc. As a result of this investigation the authors conclude that the effort to lower the cost of production in the mechanical handling of materials is becoming increasingly significant, but that variations in conditions render comparative cost estimates somewhat difficult; that a fairly simple classification of direct cost is possible; that in average installations the electric cost is in the neighborhood of 50 cents an operating hour; that in specific installations there is considerable variation in cost; that the influence of operating conditions is capable of being analyzed, and that indirect savings are always present, though difficult of valuation.—*Electric Vehicle*, March, 1928.

Miscellaneous

The Vacuum Slip Process of Removing Air from Clay Bodies.—G. W. LAPP.—The author has described the fundamental considerations involved in the slip-process manufacture of plastic wet process electrical porcelain bodies. The method of manufacture has been outlined as the passage of the clay through a tank in which the air content is evacuated by boiling. The ability of the clay filter cakes to reabsorb a small amount of air insures freedom from air in the clay if the milling devices are properly designed and operated. The advantages of such a manufacturing process are outlined and the method of determining the air contents is also given. The latter involves the compression of the sample in a liquid-filled chamber. It is stated that determinations may be made by this method with an accuracy of one-hundredth of 1 per cent. This test procedure was devised by Professor Bridgeman and is stated to have been highly successful.—*Journal of the American Ceramic Society*, February, 1928.

News of the Industry

Massachusetts Rate Bill Postponed a Year

State Senate Accepts Committee's Recommendation to Put Utilities Commission's Plan Over Until Next Session—Attwill Protests

THE proposed bill of the Massachusetts Department of Public Utilities forcing electric and gas companies to accept commission regulation without appeal to the courts in case of unacceptable decisions on rates has been referred to the next session of the Legislature by the report of the Senate committee on power and light. The Senate accepted this report on Wednesday. The committee tried to draft a permissive bill but encountered so many obstacles that no agreement was possible. The constitutionality of the bill was sharply questioned in the committee discussions.

Commenting on the report of the committee, Chairman Attwill of the Massachusetts Department of Public Utilities said that the board will continue its fight to establish the principle that the public shall not be required to pay rates based on surplus earnings taken from the public through excessive charges or based on fictitious and fanciful valuations. He declared that unless in the near future the commission shall succeed in this effort, there will be no relief from extortionate charges except through public ownership.

Protests Against Plant in the Royal Gorge Number 150

A crowded audience assembled at Pueblo, Colo., on March 29, when the application of the Public Service Company of Colorado to build a hydro-electric plant in the Royal Gorge, near Canon City, came before the Public Utilities Commission of the state at an open hearing. This application has aroused unusual interest on account of the allegation that the plant would destroy or injure the scenic beauty of the gorge, well known to travelers through that territory. One hundred and fifty formal protests against it have been registered. The project had been referred back to the state by the Federal Power Commission on account of the strong opposition, that commission saying: "The question whether or not this project should proceed in view of possible conflict with other interests seems peculiarly a matter of state concern, over the decision of which the state, having the authority, should assume the responsibility."

V. L. Board, general superintendent of the company, said that it would not go ahead in the face of opposition, but would be willing to agree to a stipulation for the exemption of sufficient water to maintain the scenic feature of the gorge. He dwelt on the cost of natural gas and coal as fuels. E. Clinton Jansen, company engineer, said that the plant could be operated without any loss to the natural beauty of its surroundings. Barton M. Jones, an engineer representing the Denver & Rio Grande Western Railroad, which is fighting the hydro project vigorously, held that the Public Service company could find other sites, naming one on the St. Vrain River.

Santa Cruz Defeats Municipal Water and Power Scheme

The proposed municipal water and hydro-electric power project designed to make the city of Santa Cruz, Calif., tax-free in ten years was defeated by the voters on March 29. The vote stood: For, 1,774; against, 2,390. The vote was the heaviest ever recorded for the thirteen precincts of Santa Cruz. It had been proposed to erect a dam above the city to supply Santa Cruz with municipally owned water service and to sell power to local industries.

Three Committeemen Attack Shoals Bill

Minority Report to House Says It Involves "Enormous Waste of Public Money"—King for New Study of Boulder Dam—Utility Quiz Next Week

By Paul Wooton
Washington Correspondent of Electrical World

A VIGOROUS minority report on Muscle Shoals was submitted to the House of Representatives April 4. It was signed by Representatives Ransley of Pennsylvania, Frothingham of Massachusetts and Glynn of Connecticut. The minority report says that the corporation to be set up by the government would be "merely a start toward the goal of unlimited expenditure of government money." It attacks the provisions of the bill for fertilizer production as based on "the most expensive method." The report continues:

No provision is made for paying back past expenditures at Muscle Shoals, which amount to over $123,500,000. The Patent Office is opened to this government corporation and the patent law, though still binding on private manufacturers, is swept aside for this corporation. The bill also authorizes the expenditure of some $37,500,000 for a new dam, and not only is no provision made for amortizing this sum, but vested rights that the State of Tennessee may possess are ignored.

There were other and better bills before the committee than this one—bills which would have involved less expenditure of the people's money and been quite as effective. The War Department receives an annual rental for the water power at Muscle Shoals of $1,250,000, and the expenses are only $276,000. This is a trifle compared with the yearly revenue that could be obtained if the department were empowered to make a longer lease, but it shows that money is coming into the Treasury, that the taxpayer will be protected while waiting for a business proposition, and that there is no need of haste in accepting a bill until the right one comes before us. We object to the enormous waste of the public money involved in the present bill and to the operation in this manner by the government of what should be left to private enterprise. There is grave doubt also as to the constitutionality of this bill.

A hand in the pending Muscle Shoals legislation is being taken by the National Fertilizer Association. This body is about to issue a statement of which an advance copy has reached the Electrical World. The statement, which was to go to every senator and representative by Friday, declares that if the Norris bill shall become a law, the government will be in the fertilizer business in the fullest sense and a cardinal American principle thus be overthrown. The association asserts that of all important supplies bought by the American farmer the lowest-priced is fertilizer; that the fertilizer industry, so far from profiteering, has lost $225,000,000 since 1920 through overproduction, and that the Norris plan would utterly fail to set up a substitute and would in itself be an economic crime.

Asks New Study of Boulder Dam

With a definite place assigned to the Boulder Dam bill on the Senate's legislative program, there is increased interest in the effort being made to require a further engineering study before final action is taken. A bill introduced by Senator King of Utah to bring about such an investigation contains the following provisions:

The President is hereby authorized and empowered to make an investigation to determine the most economical, available and effective means for the utilization of the water resources of the Colorado River basin, including the Colorado River proper and all of its confluences and tributaries, and for this purpose the President is authorized to appoint, by and with the

advice and consent of the Senate, a commission to consist of three persons, two of whom shall be engineers of recognized standing who are not interested in any project for the use of any such water resources and another person who has a practical knowledge of hydraulics and the financing of enterprises for the use of water for irrigation and for the generation of power.

Senator King's bill goes on to particularize what the proposed investigation shall cover, including stream flow, present use of waters, silt deposit, irrigation, flood control, reservoir sites, cost of dams and other works, potential generation of power, physical relations of upper and lower basins as regards water supply, the projected all-American canal and the existing situation affecting Mexico. The bill asks for "general and comprehensive conclusions upon all factors involved," together with cost estimates.

Utility Hearing Next Week

The Federal Trade Commission announces that its next public hearing in connection with its investigation of public utilities will be begun in Washington on Wednesday, April 11, when documents pertaining to publicity methods obtained from three large utility associations and one state utility information office will be introduced. Recent charges to the effect that the Copley Press, Inc., of Illinois and California, is controlled by utility interests will be gone into. Documents to be introduced will be from the files of the New York and Washington offices of the Joint Committee of National Utilities Associations, the geographic divisional office of the National Electric Light Association at Springfield, Ill.; the Chicago office of the Illinois Committee on Public Utilities Information, and offices of the American Gas Association, in all of which places investigators for the commission have been at work. Records in several other divisional offices of the N.E.L.A. are being examined by specially detailed men. Representatives of the various associations will be subpœnaed.

The Federal Power Commission has disapproved legislation proposed by Senator McKellar and Representative Garrett, both of Tennessee, which would remove the non-navigable tributaries of navigable streams from its jurisdiction.

Southwestern Men Report Excellent Year

Good Spirit and Optimism Pervade Meeting on the Gulf Coast—National and Division Officers Tell of Progress—Onken Views Present-Day Tendencies

THE Southwestern Geographic Division of the National Electric Light Association, which embraces electric public utility companies operating in the States of Oklahoma, Texas, Arkansas, Louisiana and Mississippi, held its eighth annual convention at Edgewater Gulf Hotel, Biloxi, Miss., on April 2 to 5. The attendance and spirit which pervaded the convention were excellent, owing primarily to the interest which executives have shown this year and to the excellent committee reports.

Numerous men from outside the division addressed the meetings. Prominent among the latter were President H. T. Sands and Managing Director Paul S. Clapp of the national association; W. H. Onken, Jr., editor of the Electrical World; E. C. Stone of Pittsburgh, chairman of the Engineering National Section; T. O. Kennedy of Cleveland, vice-chairman of the Commercial National Section; Dean C. O. Ruggles of Ohio State University; J. F. Owens, chairman of the Public Relations National Section, and Earle W. Hodges of H. L. Doherty & Company.

Mr. Sands and Mr. Clapp told of the aims and accomplishments of the National Electric Light Association, explaining in some detail the work of the various committees and the functioning of the thirteen geographic divisions. The work of the Southwestern Division was described by E. E. Armstrong of Gulfport, Miss., president of the division. He attributed its excellent record during the past year to the men and women on the firing line and to the support which their activities merited and received from the executives of the majority of the companies in the five states.

Mr. Onken showed the great extent to which the Southwest has been benefited by the operations of the electric light and power companies and how these, relying chiefly on natural gas, oil and powdered lignite for fuel, are no greatly concerned over water power and coal. He made a plea for the coordination of agriculture and machine-operated industry in the interest of a balanced economy to insure the economic independence of the United States and presented a broad view of the farm problem and the part electricity can play in it. He touched upon the legislative situation and the present era of consolidations and mergers. The processes of consolidation, he said, must go on to the very ultimate of their economic application, and in the process there must be a scrapping of obsolete and inefficient equipment because operating margins are becoming so small that neither thrill nor benefit can be derived out of a wasted dollar.

Of the many good committee reports the most noteworthy was that of the Engineering Section. Its hundred pages were filled with practical suggestions and descriptions of electrical and other engineering applications peculiar to the Southwest. Another noteworthy move was reported by the power division of the Commercial Section. It has initiated and partly developed an excellent power reference manual to facilitate the work of the electric light and power companies in obtaining power business.

Officers for the ensuing year were elected as follows: President, J. G. Holtzclaw, Gulf States Utilities Company, Beaumont, Tex.; vice-presidents: C. R. Bertron, Jr., Houston Lighting & Power Company, Houston, Tex.; F. W. Insull, Public Service Company of Oklahoma, Tulsa; H. C. Couch, Arkansas Power & Light Company, Pine Bluff; M. T. Walker, Southwestern Gas & Electric Company, Shreveport, La.; B. E. Eaton, Mississippi Power Company, Gulfport. S. J. Ballinger, San Antonio (Tex.) Public Service Company, was re-elected as secretary.

Federal Radio Commission Members Confirmed

Confirmation by the United States Senate of four presidential nominees to the Federal Radio Commission was finally obtained on March 30. These were O. H. Caldwell of New York, Sam Pickard of Kansas, Harold A. Lafount of Utah and Ira E. Robinson of West Virginia. Mr. Robinson was recently appointed to fill the place of the late Admiral Bullard. The other three were *ad interim* members, Mr. Caldwell having served since the commission was formed a year ago. Senator Dill again led the opposition to Mr. Caldwell's confirmation, accusing him of favoritism to the Radio Corporation of America and other interests, but the commissioner won by a vote of 36 to 35.

The commission now has its full membership of five. It has still to elect a chairman. Judge E. O. Sykes of South Carolina, the only previously confirmed member, has been acting in that capacity.

Public Service's Substation at Union City, N. J.

The first distribution substation of so-called 1927 design was connected to the lines of the Public Service Electric & Gas Company on March 18. It is known as the Union City substation. It was designed and constructed by the Public Service Production Company and embodies several novel features. The transformer banks are separated by brick fire walls, which are not ordinarily employed in other than major installations. The arrangement of the switchboard, on the second floor of the substation, follows the standard recently adopted for transformer and low-tension-feeder panels but inaugurates a new departure in other respects. The transformers and the 4,150-volt circuits are controlled from panels arranged in front of the individual circuit-breaker positions in such a way as materially to shorten the length of conduit runs and as to provide a space between each panel for ready access to the circuit-breaker solenoids and to the wall-mounted line-drop compensators. The remaining panels in the substation are installed back to back, parallel to the low-tension-feeder panels, the rear panels being used

for relays and the front panels, which are hinged, for high-tension-line control switches and indicating instruments.

The substation is situated on the side of a hill and therefore required special consideration in the layout of the outdoor equipment, it being necessary to obtain a terraced effect. Connection is to a double 26,400-volt loop, two three-phase circuits connecting the station to the Seventh Street substation, West New York, and two to the Hudson switching station, which latter is in turn connected to the Electric & Gas company's 132-kv. transmission system. The station supplies at 4,150 volts part of North Bergen Township and nearly all of Union City.

Buffalo General Electric Company Overcomes Mishaps

How two threatened interruptions to service in Buffalo in one week found the Buffalo General Electric Company prepared for emergency and were overcome without inconvenience to the public, few citizens knowing anything about them, is thus related by a company official, at the request of the ELECTRICAL WORLD:

Work is now under way on the rewinding of armature coils in one of the 37,500-hp. generators at the Schoellkopf station of the Niagara Falls Power Company, at Niagara Falls, N. Y. One of these coils burned out early in the evening of Wednesday, March 28. It had been observed during an inspection of the armature some time ago that the coils were nearing the end of their useful life. Complete materials for the repairs were ordered at that time and were on hand at the time of the failure. The machine was promptly dismantled, the old winding was removed and is now in the process of reconstruction. It is expected that the job will be completed in about four weeks. Insulation caught fire when the failure occurred. The operator immediately turned on the water in the sprinkler system, and the fire was completely extinguished with only slight damage. There was no disturbance on the system, as differential relays cleared the generator automatically. The company took advantage of the burn-out to replace the windings with coils of improved design.

Interconnection of power sources enabled Buffalo to avoid a serious interruption on Friday, March 30. An unusually severe windstorm, accompanied by sleet, caused trouble on the transmission lines from Niagara Falls, but through interconnected lines it was possible to maintain service until the disturbance was over. Wind direction and velocity were just right to cause whipping of the lines from the William B. Rankine station, in Niagara Falls, Ontario, and the Schoellkopf station, in Niagara Falls, New York. This "jumping" of conductors occurred only on lines running north and south, lines running east and west not being affected. The Charles R. Huntley station quickly swung into action, and with a shift in the direction of the wind the trouble soon cleared.

Ontario Hydro Reports No New Generators in 1927

Five and a Half Millions Has Been Spent on Rural Service—Total Power Output 1,073,630 Hp., Almost Identical with That for 1926.

THE annual report of the Ontario Hydro-Electric Power Commission, which was tabled in the provincial legislature on March 30, shows that the total capital expenditure in rural power districts is $5,569,179. Of this amount, $5,232,551 covers units in operation and $336,628 covers those in course of construction. No additional generators were placed in operation during the year, and consequently the growth in the load has reduced the margin between available generating capacity and the demand for power. The past year was the first since 1918 when no increase in generating capacity was made. The total increase in peak load was 71,500 hp., as against an increase of 56,000 hp. the previous year. All systems showed an increase in the average load. Taken on the whole, the peak loads showed an increase of about 11 per cent, which is close to the average growth established during the past ten years. The kilowatt-hours, however, did not increase in proportion.

The total power purchased and generated in the year was 1,073,630 hp., while the 1926 total was 1,072,387 hp. Operating conditions in the Niagara system, the report states, changed very little in the year. The load-dispatcher system inaugurated in 1926 was continued and developed to give the greatest possible power output for the amount of water which the commission is allowed to divert from the Niagara River. An increase of 66,000 hp. in this load, or about 11 per cent, is reported.

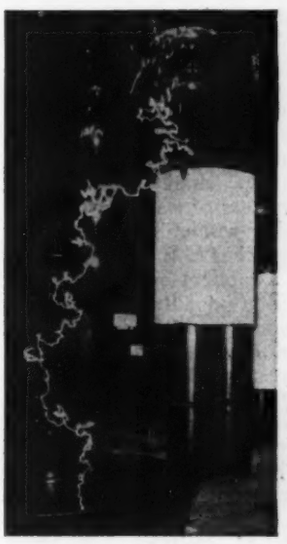
Dealing with the Georgian Bay system, the report states that there was an increase in the load over 1926 resulting from the increases in industrial loads and the operation of new industries. The load on the St. Lawrence system increased very rapidly during the year, and this was covered by arrangements with the Cedars Rapids Transmission Company to increase the power contract to the extent of 1,200 additional horsepower. The demands for power on the Central Ontario and Trent system show a substantial increase. Both peak and average loads in the Nipissing system showed heavy increases over the previous fiscal year.

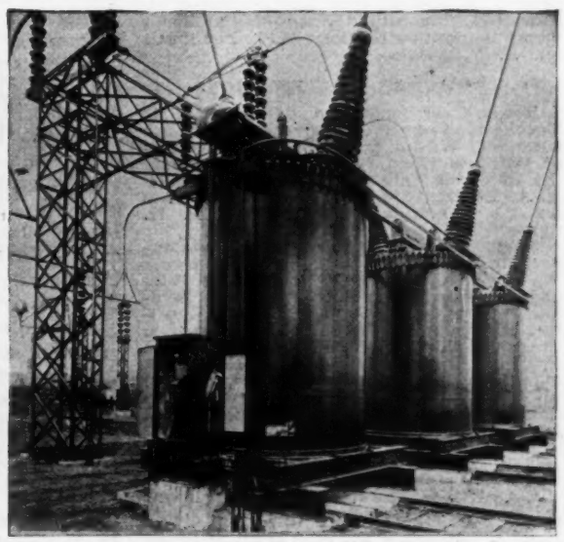
Gadsden on Issue Raised by Muscle Shoals Bills

Legislative invasion by the federal government of the field of private enterprise as embodied in the Muscle Shoals resolutions recently reported at Washington was discussed at Newark, N. J., on Wednesday evening by Philip H. Gadsden, vice-president of the United Gas Improvement Company and vice-chairman of the Joint Committee of National Utility Associations. Mr. Gadsden spoke before a gas conference. He said:

"Reduced to essentials the question is: Shall the federal government confine its activities to the political field, leaving its citizens free by their initiative and enterprise and self-reliance to develop the field of business? Has the time come when we can safely turn over to the government the management and control of the electric power industry, one of the chief factors in our amazing industrial development?"

Oil Breakers Withstand a Million Volts





ON THE right are shown three 220,000-volt oil circuit breakers built by the General Electric Company for the Philadelphia Electric Company and recently subjected to a test at 1,000,000 volts. A spectacular view of a discharge at that voltage is shown on the left. The arc measured 18 ft.

Regional Spring Programs for Institute

Baltimore Gathering Will Discuss Dielectrics and Power Generation—New Haven Meeting Will Take Up Unusual Technical Developments in Connecticut

DETAILS of the two spring regional meetings of the American Institute of Electrical Engineers—that of the Middle Eastern District at the Hotel Belvedere, Baltimore, April 17-20, and that of the Northeastern District at New Haven on May 9-12—have been made public. At Baltimore dielectrics and power generation will come in for special attention, and papers describing the Gould Street station of the Consolidated Gas, Electric Light & Power Company and the Conowingo plant of the Philadelphia Electric Company by engineers with these respective companies will be included. Inspection trips to the two plants just named will be made—the first on Wednesday afternoon, the second on Friday morning. On the evening of Tuesday Dr. R. W. Wood, professor of experimental physics at Johns Hopkins University, will lecture on "Sounds That Burn." Many entertainment features will be provided. The chief items in the technical sessions follow:

TUESDAY, APRIL 17

Afternoon.—"Behavior of Dielectrics," R. R. Benedict, University of Wisconsin; "Thermal Method of Standardizing Dielectric-Power-Loss Measuring Equipment," J. A. Scott and H. W. Bowsman, General Electric Company, and R. R. Benedict, University of Wisconsin; "Developments in the Insulation of Coils for High-Voltage Turbo-Generators," C. H. Hill, Westinghouse Electric & Manufacturing Company; "Drying and Evacuating of Impregnated Paper Insulation," J. B. Whitehead, W. B. Kouwenhoven and F. Hamburger, Jr., Johns Hopkins University.

WEDNESDAY, APRIL 18

Morning.—"Gould Street Generating Station of Consolidated Gas, Electric Light & Power Company," A. S. Loizeaux; "Design Studies for Gould Street Generating Station," F. T. Leilich, C. F. Follmer and R. C. Dannettel; "Operating Experiences at Gould Street Generating Station," A. L. Penniman and F. W. Quarles.

THURSDAY, APRIL 19

Morning.—"Conowingo Hydro-Electric Development on the Susquehanna River," Alexander Wilson, 3rd; "Electrical Features of the Conowingo Generating Station and the Receiving Substations at Philadelphia," R. A. Hentz; "220-Kv. Transmission Lines for the Conowingo Development," P. H. Chase.

Afternoon.—"Telephone System in Connection with the Conowingo Development," W. B. Beals, Chesapeake & Potomac Telephone Company, and E. B. Tuttle, Bell Telephone Company of Pennsylvania; "Quantitative Mechanical Analysis of Power-System Transient Disturbance," R. C. Bergvall and P. H. Robinson, Westinghouse Electric & Manufacturing Company; "Superexcitation for the Synchronous Condensers for the Conowingo System," D. M. Jones, General Electric Company.

NEW HAVEN PROGAM

One of the sessions of the New Haven meeting will be devoted to a joint symposium arranged by the committee on instruments and measurements and on protective devices. Three other sessions will be based on four unusual technical developments in the vicinity of New Haven which will be about completed by the time that the meeting is held. These are in the field of hydro-electric development, railroad and street-railway power and mercury turbines.

The Connecticut Light & Power Company is completing a development by which the excess flow of the Housatonic River will be pumped into a storage basin through utilization (a) on some occasions of a portion of the excess water power and (b) on other occasions of steam power from other points on the system. This will be the feature of an all-day inspection trip on Saturday, May 12, and will also be covered by a paper by E. J. Amberg of the Connecticut Light & Power Company. Similar papers dealing with corresponding development of other rivers in New England and the South are in preparation.

The fact that power for the trolley system of Bridgeport is being supplied exclusively by mercury-arc rectifier substations, one of which is entirely automatic, will be the subject of two papers, one by G. E. Wood of the Connecticut Company, on the principles and details of the installation, and a second by C. J. Daly of the Southern New England Telephone Company, on the handling of inductive co-ordination. To inspect the New York, New Haven & Hartford Railroad electrification—now being supplied with 25-cycle power through two variable-ratio frequency-changer sets, one of which derives power from another 25-cycle system, the second from a utility system at 60 cycles—will be the object of another inspection trip, and papers by Ludwig Encke of the railroad and E. J. Burnham of the General Electric Company will be read. C. F. Schuchart, Commonwealth Edison Company, and W. K. Vandersluis, Illinois Central Railroad, will present a paper on a similar phase of the Illinois Central electrification.

The 10,000-kva. mercury-boiler turbine being installed at the South Meadows station of the Hartford Electric Light Company will be operating before the date of the sessions, and there will be a paper describing that installation and discussion by the company officers. An inspection trip to this installation will also be made.

Besides these events, there will be another session including miscellaneous topics made up chiefly of "initial" papers by members of the district. The Friday morning session will be turned over to the branches of the Northeastern District for a student program, along the lines of that at Pittsfield in 1927. The three evenings will be devoted to a reception and dance, a banquet and a theater party, respectively. Those attending the convention are to see a complimentary performance by the Yale University department of drama at the University Theater.

For the summer convention of the Institute, to be held at Denver June 25-29, electrified railroad equipment, surge investigations, carrier current, geophysics, operation at high altitudes and engineering education will be among the topics.

Electrification of Railroads Makes Progress in East

As already reported from time to time, several Eastern railroads are busy with electrification programs. The Pennsylvania Railroad has almost completed the overhead installation from Wilmington, Del., to Philadelphia. A trolley voltage of 11,000 will be used at first on this section of the railroad, and power will be purchased from the Philadelphia Electric Company for both this section and that from Philadelphia to West Chester.

It is now reported on good authority that the Pennsylvania has authorized further electrifications which will be made in successive steps. These include the main line from Philadelphia to Newark and the line from Philadelphia to Pittsburgh. Newark will replace Manhattan Transfer as the station where a change to the downtown New York tubes can be made. Power will be purchased by the Pennsylvania from adjacent utilities, and a large generating station is being designed by the Public Service Company of New Jersey to afford the required energy in its territory as well as to care for system load growth.

Delaware & Lackawanna commuters have offered to pay increased fares to New York if this railroad will carry out its electrification plans, and it is asserted, though not confirmed, that the project will be started soon.

The plans of the Philadelphia & Reading Railroad to electrify its line from Philadelphia to Langhorne, Pa., a distance of 24 miles, have previously been reported.

The New York Central & Hudson River Railroad has made an analysis of the economies and service advantages of electrification from New York to Albany and thence to Buffalo, and a favorable decision is expected in the near future.

The extended utility systems make possible an adequate power supply in these regions, and the use of high-voltage trolleys combined with purchased energy reduces the railroad investments very materially. In the next few months a very large electrification program for these Eastern railroads is likely to be adopted.

Engineering College for Los Angeles' University

Next September will see the inauguration of a college of engineering at Los Angeles, established as part of its educational equipment by the University of Southern California. This university began courses in engineering 23 years ago, and the increasing demand for technical education has now led it to set up the new college, which will provide adequately equipped laboratories and facilities. There will be five major divisions, devoted respectively to chemical, civil, electrical, mechanical and petroleum engineering. Prof. Philip S. Biegler will be the first dean as well as

the head of the electrical engineering division. Four-year courses will lead to the degree of bachelor of science in any of the divisions, and masters' degrees will be awarded for graduate work.

Southeastern Division Miami Program Adopted

Headquarters for the Miami Beach (Fla.) convention of the Southeastern Geographic Division, N.E.L.A., to be held on April 11 to 14, will be at the Roney Plaza Hotel. Main features of the program follow:

WEDNESDAY, APRIL 11

Morning.—President's address, Joe H. Gill; address, H. T. Sands; merchandising talk, Harrison Jones; address, John M. Hager, United States Department of Commerce.

Afternoon.—Committee reports.

THURSDAY, APRIL 12

Morning.—"Functions of the Public Relations Section," John F. Owens; "Southeastern Public Relations Section and Its Work," Jackson P. Dick; "Accomplishments of the Southeastern Engineering Section," R. W. Lamar; "How Can the Southeastern Commercial Section Be of Service?" A. B. Collins; "Accomplishments of Southeastern Accounting Section," H. W. Boozer.

Afternoon.—Engineering, Commercial and Accounting Section meetings.

FRIDAY, APRIL 13

Morning.—"Developments in the Electrical Industry," Paul S. Clapp; address, Miss Eloise Davison; "Developing Domestic and Commercial Load," Phillips B. Shaw; address, Dr. Gus W. Dyer, dean School of Economics, Vanderbilt University; "Electricity on the J. C. Penney Small Farms" and "Rural Electrification Development in the Southeast," by representatives of the Florida Power & Light Company.

Experts Say Inadequate Foundations Caused Dam Failure

Findings of a commission of six experts appointed by Governor Young of California to investigate the cause of failure of the St. Francis Dam in southern California on March 13 are embodied in three conclusions in a report filed with the Governor. These conclusions are: (1) Failure of the dam was due to defective foundations. (2) There is nothing in the failure to indicate that the accepted theory of the gravity-type dam is in error. (3) Failure of the structure indicates the desirability of having all such structures erected and maintained under supervision and control of state authority.

The engineers report that samples of foundation taken from underneath the westerly wall quickly softened and changed to either a mush or a granular mass when immersed in water. "Unfortunately, this material," the report finds, "is of such nature that when entirely dry it is hard and rocklike in appearance and characteristics, although defective in compressive strength. With such a foundation the ultimate failure of this dam was inevitable, unless water could have been kept from reaching the foundation.

"Photographic evidence and the testimony of witnesses showed that little seepage passed through the structure of the main dam. Certain cracks developed in the main structure which possibly discharged an unimportant amount of water, not at all unusual in concrete dams. Much more important seepage is reported to have taken place through the foundation upon which the dam rested. As the water rose in the reservoir, this foundation seepage appears to have increased to a maximum of between one and two second-feet on the afternoon preceding the failure. Rumors of muddy water seeping under or around the dam before its failure are in circulation, but the commission has been unable to verify them."

A similar finding was made on Wednesday of this week by a board of engineers and geologists appointed by the Los Angeles District Attorney. This board declared that the dam should never have been built on the site selected.

Purchases and Mergers

Southeastern Power & Light Acquires Edisto Company in South Carolina—Absorption of Small Municipal Plants Into Company Systems Goes On

SALE of the Edisto Public Service Company, which, with headquarters at Denmark, S. C., serves 23 rural communities in Barnwell, Bamberg, Allendale and Hampton Counties in that state with light, power, water and ice, to the Southeastern Power & Light Company is announced. The Edisto company was formerly controlled by the Atlantic Public Utilities.

The California Railroad Commission has approved the purchase by the Great Western Power Company of California of the Feather River Power Company (ELECTRICAL WORLD, March 31, page 676).

Directors of the New Bedford (Mass.) Gas & Edison Light Company are considering an offer for the utility company from the Eastern Utilities Association.

The Public Utilities Corporation has acquired the electric lines owned and operated by Dr. E. M. Nichols at Barton, Vt., which, as reported last week, the town of Barton voted to acquire and operate. Discovery that the town could not take over the utility without legislative enactment, which could not be had until January, 1929, caused the town to turn its option over to the Public Utilities Corporation, a subsidiary of the W. B. Foshay Company.

Stone & Webster have announced that a majority of the common stocks of the Blackstone Valley Gas & Electric Company, the Edison Electric Illuminating Company of Brockton, Mass., and the Electric Light & Power Company of Abington & Rockland have been deposited in exchange for shares in the Eastern Utilities Association (ELECTRICAL WORLD, March 10, page 525). The plan of merger has therefore been declared operative.

The Connecticut Power Company has announced that a recently acquired minority interest in the Union Light & Power Company, Unionville, Conn., implies no intention of obtaining control. The Union company is an independent utility.

The Southern Light & Power Company of Maryland has purchased the Millington (Md.) Electric Light & Power Company's lines and plant from C. S. Church, who recently developed the property.

Efforts to acquire the municipal electric light and power plant in Centreville, Md., together with the pole lines and equipment owned by the towns of Queenstown and Church Hill, have been renewed by J. H. Drake, vice-president of the Eastern Shore Public Service Company, who offers in writing "to pay a price in excess of $160,000 if the Public Service Commission should determine, after a thorough investigation, that the value of your property is in excess of the price we are offering."

Authority to purchase the Home Light & Power Company, serving five small communities in Henry County, Ind., from Frank Crull for $35,000 is sought by the Interstate Public Service Company.

An offer from the Inland Utilities Company of Kansas City of $155,000 for the light plant at New Albany, Miss., was rejected by a vote of 447 to 28 last week.

Further delay in getting before the Indiana Public Service Commission the plan arranging the consolidation of the Terre Haute, Indianapolis & Eastern Traction Company properties with the power-distributing properties of the Central Indiana Power Company has been occasioned by an alteration in the conditions for the exchange of securities, and many months may yet elapse before the deal is consummated.

A proposal for sale of the municipal electric plant at Monroe, S. D., to the Northern States Power Company of Sioux Falls will be submitted at a special election April 17.

The Kentucky-Tennessee Light & Power Company has bought the city light and power plant at Trezevant, Tenn., for $16,600.

Citizens of Erick, Okla., on March 27, by vote of 228 to 90, approved sale of the municipal electric light and power plant to the Southwestern Light & Power Company. Several months ago Erick voted a franchise to the company, but a proposal to sell the plant at that time failed to get the necessary 60 per cent of the vote.

The annual report of the Telluride Power Company of Utah says that control of the Big Springs Power Company and the Pahvant Power Company was taken last year.

The Canadian Hydro-Electric Corporation, which controls the hydro developments of the International Paper Company in Canada, has announced the taking over of three hydro-electric plants on the Ottawa River. Two of these, owned by the Ottawa & Hull Power Company, are at the Chaudière Falls, Hull, Quebec, and the third station, owned by the Ottawa River Power Company, is at Bryson.

Bill to Condemn Seattle Utility Property Not Hailed

A bill has been introduced in the Seattle City Council by Councilman W. T. Campbell which provides for the city's condemning or otherwise acquiring the properties of the Puget Sound Power & Light Company. The bill has some support, in a general way, among the councilmen, but on the whole is considered untimely for any practicable purpose. The proposed measure provides an initial appropriation of $25,000 for an appraisement of the company's holdings, including its distributing system within the city and the power plants on White River, Baker River and at Snoqualmie Falls. Oliver T. Erickson, chairman of the City Council utilities committee and long a leader among municipal ownership supporters, attacks the plan as "absurd and destructive."

Briefer News

SEVEN OHIO MUNICIPAL PLANTS SOLD IN 1927.—Seven municipal light plants in Ohio were sold to privately operated companies during 1927, according to a report of the Ohio Committee on Public Utility Information—Johnstown, Piketon, Waverly, Peebles, Olmsted Falls, Jefferson and Milbury. Twenty-one in all were sold in the past five years.

COLORADO ELECTRICAL MEN GET TOGETHER.—The third annual state-wide meeting of Colorado electrical men, under the sponsorship of the Electrical League of the state, held on March 26 at the Cosmopolitan Hotel, Denver, was addressed by B. J. Rowan, J. J. Cooper, Clyde L. Chamblin, G. B. Buck and others. C. N. Shannon led a round-table discussion on the relationship of the various groups.

UNITED PUBLIC SERVICE COMPANY TO ESTABLISH HEADQUARTERS AT GREENVILLE, OHIO.—The United Public Service Company has purchased the Buckeye Overall building at Central Avenue and Pearl Street, Greenville, Ohio, and will make its headquarters there, according to announcement by A. O. McDonald, general manager of the Indiana-Ohio division, which embraces eight public service companies.

YAZOO CITY, MISS., TO SELL POWER.—A ten-year contract has been drawn up between the municipal authorities of Yazoo City, Miss., and the Mississippi Utilities Company of that place by which the city will sell power to the company, which in turn expects to furnish the towns of Louise, Midnight and Silver City, thus reversing the usual procedure where public and private plants cooperate.

NEW MEXICO POWER COMPANY HAS NEW PLANT.—The New Mexico Power Company has completed its 3,800-kw. generating plant at Dawson, built at a cost of $400,000. It replaces a plant operated by the Phelps Dodge Corporation for its coal mines and is connected with the Trinidad (Colo.) plant, controlled by the Federal Light & Traction Company, New York. The plant will burn low-grade coal in pulverized form.

KETTLE FALLS PLANT, ON THE COLUMBIA, WOULD AFFORD 260,000 HP.—Development plans looking toward an ultimate hydro-electric generating capacity of 260,000 hp. at Kettle Falls, on the Columbia River north of Spokane, Wash., were revealed at a hearing in Spokane before Major John S. Butler, representing the Federal Power Commission. Three or four years would be required for the initial development, testimony showed, owing to the unusually large flow. The complete scheme would require eight generators. Ten stages of development are now planned with the operative head increasing gradually from 35 ft. to 75 ft. There was no opposition testimony offered in behalf of town or county officials, Columbia Basin irrigation project proponents or other power companies.

DAYTON POWER & LIGHT INCREASING ITS PLANT.—More than $600,000 will be expended for additional electric generating capacity at the Miller's Ford power house during the present year, according to O. H. Hutchings, vice-president and general manager of the Dayton Power & Light Company. Growing demands in Piqua and vicinity will require the expenditure of an additional $200,000 for the construction of a transmission line from the power plant in Dayton to Covington and Piqua.

OTTER TAIL POWER COMPANY'S 1928 BUDGET.—More than $350,000 will be spent by the Otter Tail Power Company this year in improvements and expansion. Nearly two-thirds of this will be spent at Jamestown, N. D., in installing new equipment in the power station and rebuilding a turbo-generator; new waterwheels will be installed at Fergus Falls, Minn., and low-voltage lines will be built to serve ten North Dakota communities at an expense of $118,000.

TWIN STATES MANCHESTER-ARLINGTON LINE IN OPERATION.—The Twin States Gas & Electric Company is distributing power from its station at Bennington, Vt., to Manchester Center, Manchester Depot, Danby and Dorset, N. H., through the recently completed 44,000-volt transmission line between Manchester, N. H., and Arlington, Vt. The first link of this line, between Bennington and Arlington, was completed in 1924.

DUKE POWER COMPANY STARTS WORK ON NEW STEAM PLANT.—The Duke Power Company has begun construction work on the first unit of its steam plant at Riverbend, on the Catawba River, 12 miles from Charlotte. The generating equipment to be used in the first unit will include two 56,000-kw. turbo-generators served by four boilers under which coal will be burned. A possible eventual installation of 450,000 kw. in this plant is announced.

MANITOBA POWER COMPANY TO SELL SEVEN SISTERS FALLS ENERGY TO PROVINCIAL GOVERNMENT.—The Manitoba Power Company has closed a contract with the provincial government to supply 30,000 hp. annually from the company's site at Seven Sisters Falls. The contract will operate over a period of 30 years, at the end of which time the government can take over the private plant as a public utility. The power will be sold to the government at a rate of $13.80 per horsepower. A new terminal substation, costing in the neighborhood of $750,000, will be erected in Winnipeg by the Winnipeg Electric Company to take care of the production from the Seven Sisters Falls development. It will receive and distribute the additional load and effect a connection with the provincial hydro transmission system.

NEW TRANSMISSION LINES FOR SOUTHWEST ALABAMA.—Projects of the Alabama Power Company in the extension of its electric power system in southwest Alabama will cost approximately half a million dollars. A transmission line from Linden to Jackson, with substations at Jackson and Thomasville and the reconditioning of existing power plants in those places, will represent most of this. A 20-mile transmission line from Atmore to Bay

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see ELECTRICAL WORLD for Jan. 7, page 80.]

Southeastern Division, N. E. L. A.—Miami, Fla., April 11-14. C. M. Killian, 207 Bona Allen Bldg., Atlanta.

American Institute of Electrical Engineers—Baltimore regional meeting, April 17-19; New Haven regional meeting, May 9-11; national convention, Cosmopolitan Hotel, Denver, June 25-29. F. L. Hutchinson, 33 West 39th St., New York.

American Welding Society—Engineering Societies Building, New York, April 25-27. M. M. Kelly, 29 West 39th St., New York.

American Electrochemical Society—Bridgeport, Conn., April 26-28. C. G. Fink, Columbia University, New York.

Missouri Association of Public Utilities—Jefferson City, April 26-28. F. D. Beardslee, 315 North Twelfth St., St. Louis.

Arizona Utilities Association—Prescott, Ariz., April 26-28.

Southwestern Public Service Association—Dallas, Tex., May 2-5. E. N. Willis, 403 Slaughter Bldg., Dallas.

Middle West Division, N. E. L. A.—Hotel Statler, St. Louis, May 9-11. T. A. Browne, 1519 O St., Lincoln, Neb.

Arkansas Utilities Association—Arlington Hotel, Hot Springs National Park, May 14-16. R. I. Brown, Arkansas Power & Light Co., Little Rock.

American Society of Mechanical Engineers—Pittsburgh, May 14-17. Calvin W. Rice, 29 West 39th St., New York.

National Electric Light Association—Atlantic City, June 4-8. P. S. Clapp, 420 Lexington Ave., New York.

American Association of Engineers—Hotel Hussman, El Paso, Tex., June 4-6. M. E. McIver, 63 E. Adams St., Chicago.

Electrical Supply Jobbers' Association—The Homestead, Hot Springs, Va., June 5-8. E. Donald Tolles, 165 Broadway, New York.

National Electrical Manufacturers' Association—The Homestead, Hot Springs, Va., June 11-15. S. N. Clarkson, 420 Lexington Ave., New York.

Pacific Coast Division, N.E.L.A.—Hotel Huntington, Pasadena, Cal., June 12-15. S. H. Taylor, 447 Sutter St., San Francisco.

Georgia Electrical Association—Savannah, June 14 and 15. J. J. McDonough, Georgia Power Co., Dublin, Ga.

Northwest Division, N.E.L.A.—Portland, Ore., June 19-22. B. Snow, 1208 Spalding Bldg., Portland, Ore.

Canadian Electrical Association—SS. "Richelieu" from Montreal to Saguenay and return, June 20-23. H. M. Lyster, 712 Power Bldg., Montreal.

Minette, with a substation at the latter, is scheduled for early completion. A substation at the new state docks in Mobile is three-quarters completed.

LUZERNE COUNTY GAS & ELECTRIC REDUCES RATES.—A reduction in rates for electricity which, the company estimates, will result in a saving of about $100,000 a year to customers of the Luzerne County Gas & Electric Corporation, Kingston, Pa., is announced by A. J. Llewellyn, vice-president. The first 80 hours' use of meter capacity will still be charged for at 10 cents a kilowatt-hour, but following steps are reduced to 7 cents and 4 cents. A minimum monthly charge of $1 will be made.

PLAN HYDRO PLANT TO SERVE CAPE BRETON, N. S.—Development of a large hydro-power plant at Lake Ainslie, Nova Scotia, which would cost about $1,500,000 and supply most of the power needs of Cape Breton, was urged before the provincial government recently by a delegation of citizens and county officers after conferring with engineers and the Nova Scotia Power Commission. Those interested in the project will now take up the matter with the various counties in Cape Breton, with a view to assuring a market for the power in sight.

HOLYOKE WATER POWER COMPANY TO BUILD DAM ON THE CONNECTICUT.—The Holyoke Water Power Company has obtained from the United States authorities a permit to build a large hydro-electric power plant in connection with its masonry dam across the Connecticut. The plan submitted looks to four hydro-electric units having a total capacity of 40,000 hp. This installation would provide for utilization of floodwaters that now go unused during nine months of the year and would not affect the delivery of water through the hydraulic canal system. Authority is granted to make a tailrace in the rocky bed of the river and also to build a masonry wall to separate this channel from the portion of the river bed through which floodwaters naturally flow. A permit to build such a plant was granted by the Massachusetts State Department of Public Works more than a year ago.

FURTHER STAGE REACHED IN BRITISH ELECTRIFICATION SCHEME.—A further important stage in the electrification of the suburban lines of the Southern Railway of England was reached by the completion late in March of the first stage of the Central Section scheme. The complete project is to cost $18,750,000, bringing the total expenditure to $57,500,000. The section just completed comprises the lines from London Bridge to Purley, with the Caterham and Tattenham Corner branches, and from London Bridge to Crystal Palace. Included in this section are 86 miles of track equipped with the third-rail. The second section, to be opened next June, consists of 79 miles of track, about one-half of which will be converted from the overhead wire to the third-rail system. The lines embraced are those between London Bridge and Victoria and between London Bridge and Epsom Downs. The final stage of this scheme, between Victoria and Epsom and London Bridge and Dorking North, and between the City and Wimbledon, will be opened next year.

CHEYENNE COMPANY BUILDS LIGHTING SYSTEM FOR AIR MAIL ROUTE.—The Pueblo-Cheyenne air mail route, approximately 200 miles long, with stops at Colorado Springs and Denver, is one of the most recent and best-lighted airways in the United States. There are 21 beacons along the way, spaced approximately 10 miles apart. Seven are operated by electricity obtained from nearby power lines, five by acetylene gas and the remainder by power units installed in the shelter house at the base of the beacon towers, like the one shown in the illustration. Six intermediate landing fields, spaced about

30 miles apart, are lighted in accordance with the latest system. Three beacons of especial interest are those on top of Castle Rock, Spruce Mountain and the water tank of the town of Nunn, on the Colorado-Wyoming border. Construction of this airway was under the direction of F. S. Peterson of the Cheyenne Light, Fuel & Power Company, which did the work.

NO CESSATION OF ACTIVITY IN WEST TEXAS.—Demand for electric power in the oil fields of west Texas has caused the Texas Electric Service Company to adopt plans for enlargement of its power plant at Odessa at a cost of $500,000. A 60,000-volt power transmission line extends from Odessa to the Winkler County oil fields, but immediate construction of a second line has been ordered. This will necessitate the installation of additional Diesel engines and generators in the plant and an enlargement of the main building. Last year the company was obliged three times to increase the capacity of its Odessa plant.——An extension of the power transmission line of the Texas Utilities Company from Slaton to Lamesa, approximately 60 miles, will be constructed. It will be of wooden-pole construction and will cost approximately $100,000.——Construction of a 15,000-hp. hydro-electric plant in connection with its irrigation project is proposed by the Maverick County Water Improvement District in the Eagle Pass district.——Further east an extension of the 60,000-volt transmission line of the Texas Power & Light Company from Cameron to Taylor, via Minerva, Rockdale and Thorndale, will be made. The distance is about 35 miles. The line will be of wooden-pole construction.

INSULL COMPANIES' RATE REDUCTIONS IN NEW ENGLAND BRING SAVING OF $200,000.—The Central Maine Power Company has again reduced its rate schedule, bringing a saving to customers in its eastern division of more than 10 per cent. Last month the company reduced rates in the northern section of the state. Other reductions will follow, the company says. The Public Service Company of New Hampshire has reduced rates in the past year on almost all its divisions. Reductions by the Insull companies in Maine and in New Hampshire will save customers upward of $200,000 a year.

NEW ENGLAND POWER OFFICES TO BE MOVED TO BOSTON.—The entire executive offices, including the accounting and engineering departments of the New England Power Association, will be moved from Worcester to the new Batterymarch Building in Boston before Nov. 1 next. Since the organization of the New England Power Company about twenty years ago the headquarters of the management has been at Worcester, although the offices of the president and the banking interests most closely identified with the company have been at Boston. The recent acquisition by the association of the leading electric light and power utilities at Providence, Lowell and Lawrence led to the decision to centralize the managerial and allied offices at Boston, according to a statement to a representative of the ELECTRICAL WORLD by Samuel C. Moore, vice-president and general manager. The operating headquarters of the company will continue at Worcester, with load dispatching offices at Millbury, Mass., as heretofore.

STORAGE SITES FOR POWER ON EEL RIVER, CALIF.—The geology of the Mill Creek and Elk Creek dam sites and the Round Valley reservoir site on the Middle Fork of Eel River, Mendocino County, Calif., is set forth in a report prepared by the Geological Survey. An engineering examination of Eel River made in 1922 by the Survey disclosed that its value for power was largely dependent upon the feasibility of storing the floodwaters in or near Round Valley. The most promising sites for dams were found short distances below the months of Mill Creek and Elk Creek. The present geologic report, by H. T. Stearns, shows that at the Elk Creek site the north abutment of the dam

would be founded in the foot of an ancient earth slide involving an area of about a square mile. The dam could not safely be raised high enough to obtain valuable storage. The rock at the Mill Creek site, however, appears to be sound and water-tight. Round Valley has no apparent leakage. The storage capacity of Round Valley which could be developed by a dam at the Mill Creek site is greater than the annual supply of water at that place. A manuscript copy of the report may be examined at the office of the Geological Survey in Washington, D. C., or at the district office at San Francisco.

Commission Rulings

ALLOCATING COST OF SERVICE EXTENSIONS TO OLD AND NEW CONSUMERS.—The Public Service Commission of Pennsylvania has approved an agreement whereby the Pennsylvania Power Company, instead of charging new patrons to be attached to a line originally constructed at the cost of the consumers on it a lump sum to be used to reimburse those consumers for their expense, returned to the latter 80 per cent of the money advanced by them, and all consumers on the line, including those now desiring service, agreed to pay the minimum monthly charges.

BUILDING OF RURAL NETWORK IN TERRITORY ASSIGNED TO ANOTHER FORBIDDEN.—Permission to construct and operate an electrical distributing system in Sparta, Livingston County, New York, as part of a proposed network of transmission lines to serve rural communities east of Rochester, has been denied John J. O'Connell, doing business as the O'Connell Electric Company, by the New York State Public Service Commission. The commission based its action on the fact that the New York Central Electric Corporation is already equipped to serve the community. Mr. O'Connell had obtained a franchise from the Sparta Town Board under which he proposed to build a distributing line from the Niagara Power Company's line in Groveland through Sparta Township to Scottsburg. Residents and streets of Scottsburg were to be served by the transmission line. The New York Central Electric Corporation, already authorized to operate in Sparta, opposed O'Connell's petition. The company later extended its line from Sparta to Scottsburg. The commission found that business was not sufficient to warrant operation of the two companies.

ALTERNATING-CURRENT SERVICE AND COMPETITION.—Where there is a substantial demand for alternating current, as in garages, hospitals, barber shops, stores using refrigeration, cannery industries, sawmills, woodworking plants, etc., it is mandatory on an electric utility to provide energy of this character notwithstanding the original establishment of a direct-current service by the operator. This is the spirit and intent of an order entered by the Oregon Public Service Commission in connection with the determination of operating rights in Gold Beach, Ore., and involving the interests of the J. C. Leith Electric Company and the Gold Beach Electric Corporation. The issue was whether an application for a certificate of convenience and necessity for furnishing alternating current in the Gold Beach field by the Leith utility should be granted or whether exclusive privileges should be extended to the Gold Beach Electric Corporation on condition that the latter make provisions in its published tariff for the installation of rotary converters to provide alternating current wherever direct current cannot reasonably be used. The commission held that the Gold Beach company, having filed a satisfactory tariff for alternating-current service, is now adequately serving the field and is therefore entitled to all the business in the territory.

REFUSAL TO PERMIT RECAPITALIZATION ON BASIS OF REPRODUCTION COST NEW.—In denying authority to the California Water Service Company to issue securities to cover the purchase of a number of water distribution systems in California on the basis of present reproduction cost new, the Railroad Commission has affirmed its long-established rule that security issues for refinancing purposes will be allowed only upon the basis of the original cost of the physical properties of public utilities less accrued depreciation but including present-day values for lands. The commission said: "If we were to base refinancing capitalization upon an estimated 'reproduction cost new,' as is urged by applicant, a situation would be created in which even slight variations in the prices of public utility materials and supplies might quickly wipe out a part, or even the whole, of the equities possessed by common-stock holders. This commission has never heretofore allowed the capitalization of potential values, nor has it permitted public utilities after a period of operation to refinance or recapitalize their properties upon such a basis that the outstanding securities thereof would be increased to reflect an alleged 'going-concern value' claimed to have been established subsequent to the construction of the properties in question. If, in the present instance, this purchaser desires to pay, or does in fact pay, more than the amount realized from the sale of the securities herein authorized for the properties or stock of the several companies here in question, the difference between said amount and such price as the vendee may actually pay must therefore be obtained in some manner other than through the issuance of such authorized securities."

ILLINOIS COMMISSION RECOGNIZES DISTINCTION BETWEEN REFRIGERATION SERVICE AND RANGE AND HEATER SERVICE.—The Illinois Commerce Commission has reversed a previous order (ELECTRICAL WORLD, Jan. 4, page 122) in which it directed that service to electric refrigerators should be rendered at the rate for heating and cooking. That decision was based upon a consideration of the character of electric refrigerator load and its effect upon the general system load. At a rehearing evidence was introduced by the Illinois Northern Utilities Company to show that its heating and cooking rate was devised to make electric service attractive where gas was not available and to develop load even if it were necessary to forego for a time a fair rate of return. A higher rate would exceed the value of the service and limit very materially the development of this class of business. It was the contention of the utility that the average customer can obtain refrigeration at reasonable rates through the purchase of ice and that the company is therefore under no obligation to render domestic refrigeration service on the same basis as electric heating and cooking. The commission accepted this view and found (1) that the schedule for domestic electric heating and cooking as charged by the petitioner is lower than might reasonably be charged if all factors and costs, including fixed charges, were included; (2) that the rates charged for domestic electric heating and cooking are apparently not a burden on the other classes of service; (3) that the voluntary offer of a rate that is less than compensatory for a certain class of service does not justify the commission in requiring the same rate to be charged for other classes of service; (4) that the rate earned by a domestic electric refrigerator under the domestic residence lighting rate, as charged by the Illinois Northern Utilities Company, is not excessive nor greater than the value of the service.

Recent Court Decisions

THEORY THAT LOSS FROM FIRE WAS DUE TO ELECTRIC COMPANY'S NEGLIGENCE FOUND SPECULATIVE.—In Dare vs. Atlantic City Electric Company damages were sought because of the alleged negligence of the company in controlling a fire of old lumber started on its premises and said to have spread to a barn owned by the plaintiff. The trial jury had found for the plaintiff, but the Supreme Court of New Jersey set the finding aside on the ground that it showed a high degree of speculation and was against the weight of evidence. (140 At. 249.)*

POWER OF STATE COMMISSION TO TAX WATER-POWER PRODUCTION UNDER GUISE OF RENTAL DENIED.—In the decision of the Chancery Court at Nashville, Tenn., denying the right of the Tennessee State Railroad and Public Utilities Commission to tax the Tennessee Eastern Electric Company one mill per kilowatt-hour on energy produced, as a condition of the issue to the company of a certificate of convenience and necessity, and also declaring the commission's fifty-year recapture clause illegal, as noticed under "News of the Industry" in the ELECTRICAL WORLD for March 31 (page 673), the court said: "It was contended by counsel for the defendant commission that the one-mill tax sought to be imposed was in the nature of a rental for the use of the state's property. It is not claimed that the state owns any land which will be needed in the proposed development. The Legislature has not delegated to the commission any power or authority to rent out its properties for a long period of years at the price of one mill per kilowatt-hour or upon any other terms, even though it be said the state has the proprietary rights in the waters of such streams, a point not necessary to be decided. The powers given the commission are regulatory, relating to the public utilities and the conduct of their business, and it is without power to grant, bargain, sell, lease or otherwise dispose of or confer any sort of title to any property for the use of which the state might have a right to claim rentals." The recapture clause was declared confiscatory under the constitution of the state, which says that "no man's particular services shall be demanded, or property taken or applied to public use, without just compensation being made therefor."

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

F. M. FERRELL of the Kansas Gas & Electric Company, Wichita, has been made agricultural engineer for the company in the Newton district.

J. H. MCCOMBS, formerly distribution engineer of the Georgia Power Company in Atlanta, has been appointed division superintendent of operation in Rome.

J. R. ENGLISH has been appointed commercial manager for the Pennsylvania group of properties of the Associated Gas & Electric System, with headquarters at Johnstown.

W. J. CAHILL has been appointed superintendent of power supply substations of the New York Power & Light Corporation, in charge of the operation and maintenance of the substations of the company.

JOHN HURLEY has been appointed publicity manager of the Winnipeg Electric Company, Winnipeg, Man., to succeed H. C. Howard, who has left the service of the company. Mr. Hurley was formerly a local newspaper man.

WARD CHITTENDEN has been appointed manager for the Missouri Electric Power Company at Marshfield. Mr. Chittenden has been connected with the company since it acquired the Marshfield plant, and previous to that was engineer for the plant.

HENRY OLIVER, president of the Oliver Iron & Steel Corporation, Pittsburgh, Pa., has resigned to become chairman of the board of directors. BERTRAM D. QUARRIE, formerly connected with the American Steel & Wire Company and with the Otis Steel Company, has been elected to succeed Mr. Oliver.

HENRY F. SCHMIDT, consulting engineer of the Westinghouse Electric & Manufacturing Company, South Philadelphia, was made the recipient of the medal of the American Society of Naval Engineers for the best article submitted during the year 1927. In addition to the medal Mr. Schmidt was given an honorary life membership in the society and a cash prize for his paper entitled "Some Screw Propeller Experiments, with Particular Reference to Pumps and Blowers."

R. W. WILLIAMSON, manager of the western division of the Alabama Power Company, has been appointed general manager of the Gulf Power Company, with headquarters in Pensacola. Mr. Williamson entered the service of the Alabama Power Company in 1913 as draftsman, a position he held until he was transferred to the field, where he was engaged in construction and operating work. He left the employ of the Alabama Power Company in 1915 and was engaged in engineering work with the T. A. Gillespie Company of Parlin, N. J., and munition work for the British and United States governments. He re-entered the service of the Alabama Power Company in 1923 in the budget division, later going to the commercial department. After serving in this capacity he was made manager of the western division.

A. B. Day Becomes President in Los Angeles

Addison B. Day, executive vice-president and general manager of the Los Angeles Gas & Electric Corporation for the past four years, has been named president of that utility to succeed William Baurhyte, whose resignation

A. B. Day

was announced in the March 31 issue of the ELECTRICAL WORLD. Mr. Day is recognized as one of the leading executives in the public utility field on the Pacific Coast. His entire business career has been spent in the service of the utility which he will head. He entered the employ of the Los Angeles Light Company, predecessor of the Los Angeles Gas & Electric Corporation, in charge of the gas-stove department, in 1895, and has risen successively to the positions of bookkeeper, chief clerk in the gas department, chief clerk in the electrical department, manager of the appliance department, auditor, assistant secretary, manager of operation, general superintendent, vice-president and executive vice-president and general manager. He will retain his duties as general manager in connection with the presidency.

CHARLES L. CADLE, general manager of the Rochester Gas & Electric Corporation, Rochester, N. Y., will sail for a twelve weeks' trip to Europe April 14 to inspect various power developments. Mr. Cadle was the guest of honor at a surprise party given at the Rochester Chamber of Commerce March 28. Among those attending were Robert M. Searles, president of the corporation; J. Clarence Collins, secretary and treasurer; Joseph P. Haftenkamp, assistant general manager, and Ernest C. Scobell, general auditor.

JAMES W. CUTHBERT of the Keene, N. H., division of the Public Service Company of New Hampshire has been transferred to the Manchester office as head of the department of public relations and safety.

EUGENE MAUER has resigned as operating engineer for the Galesburg (Ill.) division of the Illinois Power & Light Company to become electrical engineer with W. A. Baehr Company, Chicago.

M. C. THOMPSON, formerly connected with the distribution engineering department of the Utica Gas & Electric Company, Utica, N. Y., has resigned to join the distribution engineering department of the Syracuse (N. Y.) Lighting Company.

GLENN R. TRUMBULL has joined the Columbia Gas & Electric Corporation as director of new business and merchandise sales for the Columbus (Ohio) group of properties. A native of Ohio and a graduate of Ohio State University, Mr. Trumbull received his early utility experience with the Union Gas & Electric Company of Cincinnati and later merchandising experience with several large utility companies.

JOHN S. MALOY has been appointed distribution engineer of the West Penn Power Company to succeed M. W. De Merit, now assistant to the president. His connection with the company covers a period of ten years and started at the laboratory in Connellsville. Subsequently being transferred to Pittsburgh, he engaged in estimating and layout work. When distribution engineering became a separate department, in 1922, Mr. Maloy became one of the four engineers comprising the department.

E. C. CONROY, formerly assistant superintendent of distribution for the southwestern district of the Puget Sound Power & Light Company, has been transferred to the western district with headquarters at Bremerton, where he will be superintendent of distribution.

MERRITT C. HUSE, formerly assistant to C. J. Russell, vice-president in charge of the commercial department of the Philadelphia Electric Company, has been appointed sales manager of the company. A native of Manchester, N. H., and a graduate of the University of New Hampshire, Mr. Huse was associated with D. C. and William B. Jackson, consulting engineers of Boston and Chicago, from 1909 to 1917. It was in 1917 that he affiliated himself with the Philadelphia Electric Company. In his new position as head of the sales department he will be in charge of power sales, lighting sales, appliance sales and industry promotion work. Mr. Huse is a

member of the Illuminating Engineering Society and is chairman of the wiring committee and a member of the industrial lighting, residential lighting and merchandising committees of the National Electric Light Association.

GEORGE E. FULLER, office manager and comptroller of the Worcester (Mass.) Electric Light Company, has been elected a vice-president of the organization. Mr. Fuller is widely known in New England central-station circles.

H. O. GROSS, formerly connected with the engineering department of the United Gas Improvement Company, has been appointed manager of the Delaware division of the Philadelphia Suburban-Counties Gas & Electric Company with headquarters at Chester.

A. N. KEMP, vice-president of the California Bank of Los Angeles, has been elected a director of the Southern California Edison Company. Mr. Kemp was formerly vice-president in charge of finance of the Southern California Edison Company but he resigned five years ago to become an executive officer of the California Bank.

A. A. BROWN has been appointed sales manager of the Oklahoma Gas & Electric Company with direct supervision over the investment and appliance departments. The identity of both departments will remain intact. Mr. Brown first joined the Oklahoma company in 1910 in the commercial department at Muskogee. From 1911 to 1917 he served as sales manager of the Northern States Power Company at St. Paul, but following military service he returned to the Oklahoma Gas & Electric Company as manager of the investment department in 1919.

WELLS STANLEY, formerly general manager of the Gulf Power Company, Pensacola, Fla., has been appointed manager of sales of the Alabama Power Company. Mr. Stanley became identified with the Alabama Power Company in 1914 as local manager at Huntsville, following the purchase by that company of the Huntsville Light, Railway & Power Company, of which he had been manager. He remained until 1917, when he was made manager of local operations with headquarters in Birmingham, later returning to Huntsville as manager of the Northern division. This position he held until his appointment in 1925 as general manager of the Gulf Power Company.

H. F. BOEHNER has resigned his position as assistant general manager of the Iowa-Nebraska Light & Power Company, Lincoln, Neb., and has organized the Midwest Refrigeration Company of Des Moines, Iowa, for the purpose of distributing General Electric refrigerators in 75 counties in the central part of Iowa. Mr. Boehner was originally interested in the Malvern Electric Company of Malvern, Iowa, which property was sold to the Continental Gas & Electric Corporation, and after operating at Malvern for the purchasers for a few years Mr. Boehner was named district manager of the Red Oak district, which embraced Malvern. Later he was transferred to the general office of the company as assistant general manager, which position he has held until the present time.

H. Carl Albrecht Receives New Appointment

H. Carl Albrecht, who has been connected with the Philadelphia Electric Company since 1909, has been named assistant operating manager of the company. A native of Philadelphia and a graduate of the University of Pennsylvania, Mr. Albrecht entered the employ of the company as assistant to H. P. Liversidge, at that time superintendent of station electrical construction. In 1917 he became engineer of the station electrical design and construction

H. C. Albrecht

division and in 1925 he was made manager of the purchasing, stores and transportation department. Mr. Albrecht has been active in the work of the National Electric Light Association, having served as chairman of the electrical apparatus committee in 1923, and also in the affairs of the A.I.E.E.

PHILIP S. BIEGLER, professor of electrical engineering at the University of Southern California for the past five years, has been appointed acting dean of the college of engineering just created at that institution. Professor Biegler removed to California five years ago after thirteen years of teaching at the Universities of Iowa, Illinois, Purdue and Washington State College and after a lengthy connection with the Commonwealth Edison Company in Chicago and the Washington Water Power Company of Spokane in an engineering capacity. From 1918 to 1921 he was associate engineering editor of ELECTRICAL WORLD. The new dean has written extensively on educational problems, constant current regulators, deep well pumping and other engineering subjects. He is a member of the American Institute of Electrical Engineers, the Society for the Promotion of Engineering Education and of other professional and academic associations.

Obituary

G. S. WILLIAMS, secretary of the Maryland Utilities Association, with headquarters in Baltimore, Md., died March 6.

THOMAS A. WILKINSON, transmission engineer for the New England Public Service Company, died at his home in Augusta, Me., of cerebral hemorrhage April 2. Mr. Wilkinson was one of the pioneers in the industry, having first been connected with Westinghouse, Church, Kerr & Company for a number of years as head of the statistical department. After the dissolution of this organization he was affiliated for a time with the Ontario Hydro Commission. Subsequently he joined the Westinghouse Electric & Manufacturing Company to supervise the work of calculating transmission line constants for its book known as "Electrical Characteristics of Transmission Circuits." He has been transmission engineer for the New England Public Service Company for the past two years.

DAVID H. DARRIN, president of the Automatic Switch Company of New York, died March 29 at his home in New Rochelle, N. Y., of pneumonia. Mr. Darrin was many years ago identified with electric light and power plants in northern New York. Subsequently he entered the electric elevator manufacturing field and after his enterprise was absorbed by the Otis Elevator Company in the early nineteen hundreds he purchased an interest in the Automatic Switch Company, which had been incorporated in 1888. Mr. Darrin was one of the oldest members of the American Society of Mechanical Engineers and was a charter member of the old Electric Power Club.

DR. DELOS F. WILCOX, well-known authority on franchises and public utility valuation matters, died of pneumonia April 4 at New York Hospital after a brief illness. He was 55 years of age. A native of Monroe, Mich., Dr. Wilcox removed to New York in 1907 to become chief of the bureau of franchises of the Public Service Commission for the First District, which was then being organized. He resigned in 1913 to enter private practice as a public utility expert, but one year later he again took public office as Deputy Water Commissioner of the city of New York. He resigned from this position in 1917 to resume his private practice. As a public utility expert he was consulted by a large number of cities on franchise rate and valuation matters. He was the author of a large number of works dealing chiefly with the problems of city government and regulation of public utilities. Before removing to New York Dr. Wilcox engaged in work relating to improved city government, first in Cleveland and later at Grand Rapids and Detroit. He was a graduate of the University of Michigan.

Financial and Statistical News

Utility Market Firm
No Drastic Changes in Prices

THE general market continued its upward spurt of the past few weeks so that interest continued to be centered in the more speculative issues. Few changes of any importance took place in the case of the common stocks of the electric light and power companies, though several did show gains. Particularly noteworthy for strength was the Brooklyn Edison Company, which advanced twelve points, reaching the highest mark in the history of the company, 245. Edison Electric Illuminating of Boston went up seven points and Public Service of New Jersey five. Many of the light and power preferred issues showed gains.

Radio Corporation touched the 195 mark, advancing from 169 during the week under review, and General Electric gained eight points, from 149 to 157.

Company Reports

Name of Company	Gross Earnings Twelve Months Ended Feb. 29 1928	1927
Associated Gas & Electric System	*$40,174,238	*$29,705,641
Bangor Hydro-Electric	1,881,770	1,763,491
Baton Rouge Electric	1,041,345	980,306
Blackstone Valley Gas & Electric & subs.	5,946,189	5,600,687
Cape Breton Electric	658,268	628,398
Central Illinois Light	4,453,060	4,244,172
Cities Service	32,951,844	27,521,058
Columbus Electric & Power	4,305,390	3,821,598
Commonwealth Power	54,020,022	49,651,699
Consumers Power	27,245,543	24,501,172
Eastern Texas Electric & subs.	7,325,083	5,892,873
Edison Electric Illg. of Brockton	1,958,721	1,786,638
Elec. Lt. & Pwr. Co. of Abington & Rockland	626,454	584,683
El Paso Electric & subs.	3,026,888	2,872,333
Galveston-Houston Electric & subs.	5,105,462	4,740,485
Illinois Power	2,650,883	2,594,248
Kansas City Powsr & Light	12,856,793	11,023,319
Northern Ohio Power	12,729,680	12,034,975
North Texas Elec. & subs.	2,780,232	2,536,280
Ohio Edison	1,956,416	1,835,339
Penn Ohio Edison	13,015,572	12,948,064
Portland Electric Power	12,201,973	11,891,001
Public Service Co. of New Hampshire & subs.	3,653,371	3,479,462
Puget Sound Pwr. & Lt. & subs.	14,961,978	13,735,428
Savannah Electric & Power	2,228,751	2,24[illegible],373
Sierra Pacific Elec. & subs.	1,258,451	1,267,873
So. Indiana Gas & Electric	3,055,241	2,924,767
Tampa Electric & subs.	4,693,978	4,905,426
Tennessee Electric Power	12,664,657	11,942,760
Virginia Electric & Power & subs.	15,624,176	14,[illegible]03,405

*Twelve months ended Jan. 31.

Canada's Output Increases 16.4 per Cent

The output of central electric stations in Canada during January totaled 1,317,736,000 kw.-hr., as compared with 1,131,212,000 in January, 1927. The increase is equivalent to 16.4 per cent. The report of the Dominion Bureau of Statistics shows that of the total, 1,297,783,000 are credited to water and 19,953,000 to fuel-using plants. Output generated from water power in the five economic areas shows a slight decline as compared with December, except in the Maritimes and British Columbia. In the former area, 10,880,000 kw.-hr. were produced, as compared with 10,686,000 in the preceding month and 9,335,000 in January, 1927. British Columbia records an increase from 91,875,000 in December to 93,340,000 in January. Production in that province has shown a steady advance in the past few years, the January total being the highest on record.

Both Ontario and Quebec record a decrease in output during January, as compared with the preceding month. The former had a production of 485,309,000 kw.-hr., as compared with 498,254,000 in December, while the latter's output totaled 611,728,000, as against 637,615,000 kw.-hr. in December. It is also noted that output in Ontario in January was less than in the same month in 1927. Output in the Prairie Provinces totaled 93,340,000 kw.-hr., a decrease of about 4,000,000 kw.-hr. from the preceding month, but compared with the total for January, 1927, there was an increase of about 19,000,000 kw.-hr.

General Electric Records Another Profitable Year

ANOTHER profitable year is added to the creditable financial history of the General Electric Company. Although orders received during 1927 declined 5 per cent, to $309,784,623, net sales billed during the year were down almost 5 per cent and unfilled orders at the end of the year were 5 per cent lower. Net profits, however, increased almost 5 per cent. Price declines explain the decreases noted.

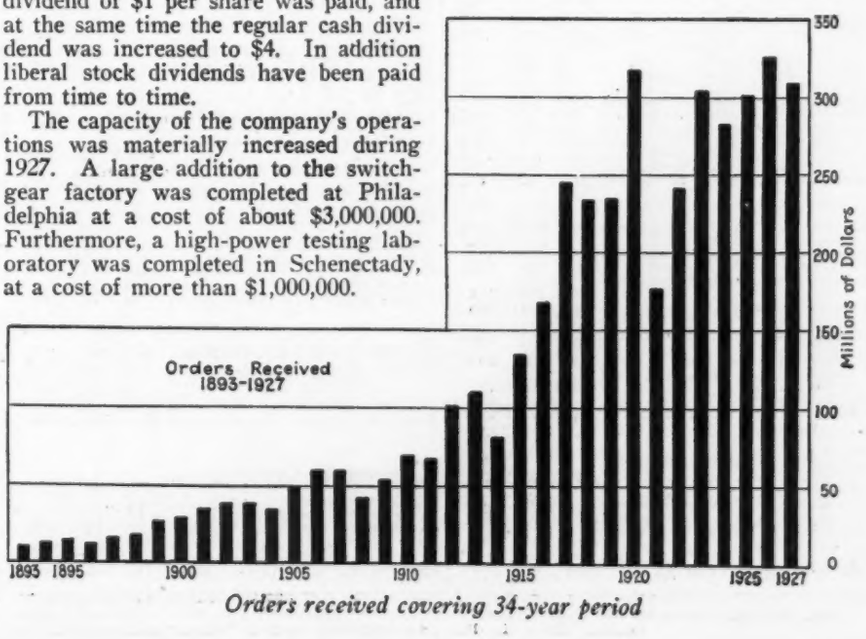
General Electric shows an unusually attractive earnings record over the past 25 years. Average profit available for dividends on common stock per share over a 25-year period was $14.84. For more than 28 years cash dividends have been paid continuously on the common stock, and from April, 1900, to and including 1926 the rate was $8 per share per year with an extra of $1 in 1917. In May, 1926, the old stock was split four for one and cash dividends of $3 per share per annum were paid on the new stock from July, 1926, to April, 1927, inclusive. Last July an extra cash dividend of $1 per share was paid, and at the same time the regular cash dividend was increased to $4. In addition liberal stock dividends have been paid from time to time.

The capacity of the company's operations was materially increased during 1927. A large addition to the switchgear factory was completed at Philadelphia at a cost of about $3,000,000. Furthermore, a high-power testing laboratory was completed in Schenectady, at a cost of more than $1,000,000.

The year was a profitable one also from the standpoint of the company's investments. An increase of nearly $19,000,000 is recorded in holdings, due partly to additional investments in associated manufacturing companies and in part to advances to enable the Electric Securities Corporation and the United Electric Securities Company to call bonds amounting to $13,440,000 and for other purposes.

Income accounts for the past two years follow:

	1927	1926
Net sales billed	$312,603,772	$326,974,103
Costs, tax., deprec.	276,454,003	289,878,335
Net op. income	$36,149,768	$37,095,768
Other income	15,395,918	12,561,526
Total income	$51,545,687	$49,657,295
Interest	284,486	436,512
Gen. reserve	2,461,712	2,548,284
Net profit	$48,799,489	$46,672,499
Special dividends	2,574,447	2,357,614
Common dividends	34,251,774	19,828,897
Stock dividend	.....	7,210,810
Surplus for year	$11,973,267	$17,275,177



Orders received covering 34-year period

Canadian Manufacturing Companies Issue Reports

Gross profits of the Canadian General Electric Company, Ltd., for 1927, after reserves and taxes, but before providing for depreciation, increased by 55 per cent, to $2,903,053, or $1,032,435 more than was earned in 1926. The net profits after writing off $800,000 for depreciation, as compared with $700,000 in 1926, amounted to $932,435 more than in 1926, or $2,103,053 available for the preference and common stocks. The sum of $599,042 was distributed in dividends during the year on the preference stock, leaving a surplus of $1,504,011, or nearly 16 per cent on the common stock. The same amount of money was paid in dividends in 1926 on the preferred stocks.

The financial report of the Canadian Westinghouse Company, Ltd., for the year ended Dec. 31, 1927, shows a further substantial increase in profits, with net earnings for the year equal to 23.04 per cent on the company's outstanding capital stock, as compared with 18.3 per cent in 1926 and 14.4 per cent in 1925. Operating profit for the year amounted to $2,551,188, as compared with $1,796,741 in 1926. Deduction of depreciation at $240,000, Dominion taxes at $187,000 and pension fund at $50,000, left net earnings at $2,074,188, against $1,366,741 in the preceding year. Dividends paid during the year amounted to $838,116, and patent, etc., reduction of $499,999 left a surplus for the year of $736,073.

GERMANY'S THREE-BILLION MARK INDUSTRY

Item	176 Generating Establishments: Amount, Millions of Marks	176 Generating Establishments: Per Cent	194 Manufacturing Establishments: Amount, Millions of Marks	194 Manufacturing Establishments: Per Cent
Invested capital as per balance sheet	1,195.9	60.6	591.8	54.7
Borrowed capital	765.5	38.8	478.5	44.2
Employees' benefit funds	12.3	0.6	11.6	1.1
Total	1,973.7	100.0	1,081.9	100.0
		Per Cent of Invested Capital		Per Cent of Invested Capital
Year's net profits	95.8	8.02	33.3	5.64
Year's net losses	1.3	0.1	8.9	1.5
		Per Cent of Capital Participating in Dividends		Per Cent of Capital Participating in Dividends
Total dividends	74.9	6.9	27.9	5.4

German Electrical Industry

The latest census of the electrical industry in Germany was taken in 1925, according to a recent report received from one of the ELECTRICAL WORLD'S foreign correspondents. The returns, covering 176 generating and 194 manufacturing establishments, are summarized in the table above.

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday April 3	Low 1928	High 1928
ABITIBI PWR. & PAPER, com., new — no par	79⅛	72	81
Ala. Pwr., $7 com. pf.—no par	k114½	114½	115½
Allis Chalmers Mfg. 6% com	123	115½	125
Aluminum Co. of Amer., com	126⅛	120	136
Aluminum Co. of Amer., 6% pf	k108⅛	105½	109½
Amer & Foreign Pwr., 7% pf.—no par	108⅛	105½	109
Amer. & Foreign Pwr., com.—no par	23⅛	22⅛	27⅛
Amer. Bosch Magneto, com.—no par	28⅛	15⅛	28⅛
Amer. Brown Boveri Elec.†	14	10⅛	18
Amer. Brown Boveri Elec., pf. $7	48⅛	46⅛	63
Amer. Gas & Elec., 6% pf.—no par	k108⅛	105	108⅛
Amer. Gas & Elec., com. †—no par	135	117	145
Amer. Lt. & Trac., 6% pf	113	116	120
Amer. Lt. & Trac., new com	194⅛	170	195
Amer. Pwr. & Lt., 6% pf	107⅛	104	109⅛
Amer. Pwr. & Lt., com. †—no par	77⅛	62⅛	83
Amer. Pub. Serv., 7% pf	a 98	97⅛	101
Amer. Pub. Serv., com. †	k 70	70	75
Amer. Pub. Utilities, 7% ptc. pf	k 95	90	95
Amer. Pub. Utilities, 7% pr. pf	99	94	101
Amer. Pub. Utilities, com	k 60	60	65
Amer. States Sec., A	a 7⅛	4	7⅛
Amer. States Sec., B	a 7⅛	4⅛	7⅛
Amer. Superpwr., 6% ptc pf.—25	m30	28⅛	30⅛
Amer. Superpwr., 6% 1st pf	l 103⅛	....	....
Amer. Sup pwr., Class A†—no par	44⅛	37	46⅛
Amer. Sup pwr., Class B†—no par	45⅛	37⅛	48
Amer. Wtr. Wks. & Elec., 6% pf	104⅛	101⅛	105
Amer. W. W. & E., com. new—no par	56⅛	52⅛	61
Anaconda Copper cap. $3	64⅛	53⅛	64⅛
Appalachian Electric Pwr., 7% pf	108⅛	108⅛	110
Arkansas Pwr., & Lt. 7% pf	107⅛	108	109⅛
Assoc. Gas & Elec., $3.50—50	54	....	....
Assoc. Gas & Elec., pf.—$6—no par	95	96	98⅛
Assoc. G. & E., Class A, 10—no par	48⅛	47	51⅛
BABCOCK & WILCOX, 7% com.	118	117⅛	124⅛
Binghamton L., H. & P., $6 pf	107	102	108
Birmingham Elec., pf.—$7—no par	105	109⅛	111
Blackstone Valley G. & E., 6% pf	m106	106	112
Blackstone Valley Gas & Elec., 10% com.—50	k160	135	165
Blaw-Knox, com.†	t102	91	105
Brazilian Trac., Lt. & Pwr., $7 com.	f229⅛	....	....
Brazilian Trac., Lt. & Pwr., com., new	f 58⅛	....	....
Broad River Pwr., 7% pf	107	105	108
Brooklyn Edison, 8% com	241	206⅛	249⅛
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	l 26⅛	....	..
Buffalo, Niagara & East. Pwr. com. $1.20—no par	l 37⅛	....	....
CALIFORNIA ELEC. GENERATING, 6% pf	99	98	101
California Ry. & Pwr., 7% pf	135	....	....
Carolina Pwr. & Lt., pf.—$7—no par	l110⅛	109	110⅛
Central & S. W. Util., $7 pf.—no par	a104⅛	99⅛	105⅛
Central & S. W. Util., pr. in. $7 pf.—no par	a108	103⅛	108
Central Ark. Ry. & Lt., 7% pf	104	105	107
Central Ill. Pub. Serv., $6 pf	a99⅛	97⅛	100
Central Ind. Pwr., 7% pf	a 99⅛	95	99⅛
Central Maine Power, 6% pf	96	96	98
Central Maine Power, 7%	106⅛	109	112
Central Pwr. & Lt., 7% pf	106	104⅛	105⅛
Central States Elec., 7% pf	112	104⅛	112
Century Elec., 6% com	b135	135	145
Cincinnati Gas & Elec., 5% com	g 99	97⅛	99⅛
Cities Service, $6 pf.—no par	l100⅛	87	94⅛
Cities Service, pf. B—no par	l 9⅛	8	8⅛
Cities Service, pf. BB—no par	l 94	80⅛	86
Cities Service, com.—20	l 57⅛	40⅛	58⅛
Cities Service, Bks. Shrs.—10	l 28⅛	22⅛	27
Cities Service Pwr. & Lt., 7% pf	k107	106	109⅛
Cities Service Pwr. & Lt., 6% pf	101	95⅛	101⅛
Cleveland Elec. Illg., 6% pf	112⅛	113	115⅛
Cleveland Elec. Illg., 10% com	390	350	410
Columbia Gas & Elec., 6% pf	109⅛	107⅛	110⅛
Columbia G. & E. com. $5—no par	93	89⅛	97⅛
Columbus Elec. & Pwr., $2 com.—no par	77⅛	64	79
Columbus Elec. & Pwr., 7%	113	....	....
Columbus Ry., Pwr. & Lt., 7%	107⅛	....	....
Columbus Ry., Pwr. & Lt., 7 % pf. B	107⅛	....	....
Columbus Ry., P. & Lt. com.—no par	115	....	....
Commonwealth Edison, 8% com	a179	165	189
Commonwealth Pwr., 6% pf	104⅛	102⅛	104⅛
Commonw'th Pwr., $2, com.—no par	73⅛	62⅛	76⅛
Conn. Lt. & Pwr., 8% pf	122	120	125
Conn. Lt. & Pwr., 7% pf	117	118	121
Cons. Gas of N. Y., pf	k104	101⅛	105
Cons. Gas of N. Y., com. $5—no par	146⅛	119⅛	149⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf	e111⅛	110	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf	e111⅛	110⅛	114⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., 5% pf	e105⅛	100⅛	104⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $3.00—no par	e 72⅛	67⅛	73
Consolidated Pwr. & Lt., 7% pf	105	....	....
Consumers Pwr., 6% pf	104⅛	105⅛	106⅛
Consumers Pwr., 6.6% pf	105	106	107
Continental Gas & Elec., 7% pr. pf	108	106⅛	108⅛
Conti. G. & E. com. $4.40—no par	k230	240	265
Crocker Wheeler, com.†	38	24	30
Crocker Wheeler, 7% pf	90	77	90
DALLAS PWR. & LT., 7% pf	111	110	111⅛
Dayton Pwr. & Lt., 6% pf	108⅛	108⅛	109⅛
Derby Gas & Elec., 7% pf	100	96	100⅛
Detroit Edison, 8% com	k182⅛	166⅛	194⅛
Dubilier Condenser, com.—no par	2⅛	2⅛	3⅛
Duke Pwr., cap	k143	130	145
EASTERN NEW YORK UTIL., $7 pf	k110⅛	111	112⅛
Eastern New York Util. com	m 65	....	....
Eastern States Pwr. $7, com	k 12	12	14⅛
Eastern States Pwr., pf	k 98	98	99
East. Tex. Elec., 7% pf	107	106	109
Edison Elec. of Boston, $12 com	d277	252	280
El Paso Elec. 7% pf	113	110	112⅛
Elec. Bond & Share, 6% pf	l110	108⅛	111⅛
Elec. Bd. & Sh. Sec., com. $1—no par	l 90⅛	76	95⅛
Electric Household Util.†	a 22⅛	13⅛	24
Elec. Investors, 6% pf.—no par	103	101	103⅛
Elec. Investors, com.†—no par	48⅛	40⅛	49⅛
Elec. Pwr. & Lt., ctfs. pf	109⅛	106⅛	110⅛
Elec. Pwr. & Lt., ctfs., 40% pd	m125⅛	120⅛	125⅛
Elec. Pwr. & Lt., ctfs., com.—no par	36⅛	28⅛	39⅛
Elec. Refrig. cap.†	m15⅛	11⅛	17⅛
Elec. Ry. Securities, com.—no par	6⅛	....	....
Elec. St. Battery com. $5.25—no par	80	69	80
Elmira Wtr., Lt. & R.R., 7% pf	106⅛	104	107
Empire Pwr., pte.†	32	27⅛	35⅛
Engr. Pub. Serv. $7, pf.—no par	110⅛	107	110⅛
Engr. Pub. Serv., com.—no par	39⅛	33	42⅛
Eureka Vacuum Cleaner, com. $4—no par	73⅛	69	79
FAIRBANKS MORSE, 7% pf	109⅛	104	110
F.-M., com.—$3—no par	40⅛	32⅛	40⅛
Federal Lt. & Trac., com $1.40	52⅛	42	55
Federal Lt. & Trac., $6 pf.—no par	103	98	105
Florida Pwr. & Lt., 7% pf	k107⅛	105	108
Ft. Worth Pwr. & Lt., 7% pf	k114	113	114⅛
GALVESTON-HOUSTON ELEC. 6% pf	78	75	78
Galveston-Houston Elec., com	38	31⅛	38
General Cable, Cl. A	79⅛	56	80⅛
Gen. Elec. $3 com.—no par	157⅛	124	161⅛
Gen. Elec., special—6%	11⅛	11⅛	11⅛
Gen. Gas & Elec. (Del.) com A $1.50—no par	41	35⅛	43⅛
Gen. G. & E. (Del.) pf. A $8—no par	125	125	128
Gen. G. & E. (Del.) pf. A $7—no par	113	110	114
Gen. G. & E. (Del.) pf. B $7	111	105⅛	111
Gen. Pub. Serv., $7 cum. pf., no par	117	110	120
Gen. Pub. Serv., com., no par	20⅛	16⅛	21⅛
General Public Utilities, $7 pf	k 58	55	65
Ga. Lt., Pwr. & Rys., com	k 58	55	65
Gt. Western Pwr., 7% pf	h105⅛	....	....
IDAHO PWR., 7% pf	104⅛	109	110⅛
Ill. No. Utilities, 6% pf	k 96	96	98
Ill. Pwr. & Lt., 7% pf	104⅛	103	107
Indianapolis Pwr. & Lt., 6⅛% pf	105⅛	102	107⅛
Indianapolis Pwr. & Lt., $7 pf	104	100	105
Ingersoll Rand com	91	90	94
Int. Combus. Engr., com. $2—no par	52	45⅛	55⅛
Int. Combustion Engr., 7% pf	t104⅛	103	105⅛
Int. Util., Class A—$3.50—no par	44⅛	45	44⅛
Int. Utilities, Class B—no par	8⅛	6⅛	10⅛
Interstate Pwr., pf.—$7—no par	102	99	103⅛
Interstate Pub. Serv., 7% pf	105	103	106
Iowa Ry. & Lt., 7% pf	101	102	103
JERSEY CENTRAL PWR. & LT. CO., 7% pf	107⅛	105	107
Johns-Manville, com.†—no par	119⅛	111⅛	125
Johns-Manville, 7% pf	m113⅛	111⅛	113⅛

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, March 31. lBid price Wednesday, April 4. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday April 3	Low 1928	High 1928
KANSAS CITY PWR. & LT. pf. $7	113	111¼	113¼
Kansas Gas & Elec., 7% pf.	*l*110	107	109
Kentucky Hydro-Elec., 7% pf.	*m*104½	102	104½
Kentucky Sec., 6% pf.	92	94	98
Kentucky Sec., 5% com.	150	140	150
Kentucky Utilities, 6% pf.	103	100	103
LACLEDE GAS LT., 10% com.	*k*210	200	260
Lehigh Pwr. Sec., com.—no par	26½	19¼	27½
Long Island Ltg., 7% pf.	111½	110¼	112½
Long Island Ltg., 6% pf.	*k*107½	107	108½
Long Island Ltg., com.†—no par	*k*187	170	185
Los Angeles Gas & Elec., 6% pf.	*h*110½	105½	109½
Louisville Gas & Elec., cl. A. $1.75	33¾	28	33¾
MAN. ELEC. SUPPLY, cap. $5—no par	55½	50	61
Manila Elec., com.†—no par	*m* 47	45½	50
Maytag Mfg., com. 50—no par	33¼	30	34¼
Memphis P. & L., pf.—$7—no par	109	109	111
Metropolitan Ed., pf.—$6—no par	108½	103	108½
Metropolitan Ed., pf.—$7—no par	109½	109	111
Metropolitan Ed., com. $5—no par	*k*160	125	155
Middle West Utilities, 7% pf.	*a*122	116½	124½
Middle West Util., 7% pr. lien	*a*125½	125	129½
Middle West Util., com. $7—no par	*a*134	123½	135
Midland Utilities, pr. in. 6% pf.	*a* 95½	94½	97
Midland Utilities, 6% pf. A	*a* 91	89½	92½
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*104	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	102	98	101½
Minn. Pwr. & Lt., 7% pf.	*l*108½	107	109
Miss. River Pwr., 6% pf.	108	94	109
Miss. River Pwr., 3% com.	*m*108	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	109	107½	110
Mohawk Hudson Pwr., 2d pf.—$7—no par	*k*104	100	109
Mohawk Hudson Pwr., com.—no par	34¼	29½	36½
Montana Pwr., 5% com.	164	102½	167½
Montreal Pwr., 7½% com.	*f* 94	....	....
Mountain States Pwr., 7% pf.	*k*104	97	105
Mountain States Pwr., com.†	17½	....	....
NASSAU & SUFFOLK LTG., 7% pf.	109	98	110½
National Elec. Pwr., A†	*a* 31½	27½	32½
National Lt., Ht. & Pwr., com.	*k* 24	20	30
National, Light, Ht. & Pwr., 5% pf.	72	70	80
National Pwr. & Lt., pf.—$7—no par	109	108½	111
National Pwr. & Lt., com.†—no par.	26¼	21¼	27½
National Pub. Serv., 7% pf.	101	99	103
National Pub. Serv., 7% pfc., pf.	114	....	....
National Pub. Serv., A com. $1.60—no par	25½	22	27½
National Pub. Serv., B com.—no par	28¼	24½	30
Nebraska Pwr., 7% pf.	*l*112	110	111½
Nevada-Calif. Elec., com.	35	22	37
New Brunswick Pwr., 4% pf.	62	60	70
New Eng. Pub. Serv., pr. in. pf. $7	*k*108	98½	109½
New Eng. Pub. Serv., pf. $7	*k*106	95	108
New Orleans Pub. Serv.—7% pf.	108	106	110
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	100	91	100
N. Y. Central Elec., 7% pf.	104½	101	105½
New York Power & Light 7% pf.	115½	....	....
New York Power & Light, 8% pf.	*m*114	....	....
NiagaraFalls Pwr., 7% pf.—25.	28	27½	28½
No. Amer., 6% pf.—50.	*k* 53½	53½	55
No. Amer., com.—10	64½	58½	67
No. Amer. Edison, $6 pf.—no par	*k*104	102½	105½
No. Caro. Pub. Serv., pf.—$7—no par	*m*109	93	105
Northeastern Pwr., com.	25½	19½	26½
No. N. Y. Utilities, 7% pf.	107	103	109
No. Ohio Pwr., com.—no par.	25½	18	27½
No. Ont. Pwr. & Lt., 6% pf.	98	90	99
No. Ont. Lt. & Pwr., 4% com.	*k* 72	73	78
No. States Pwr. (Del.), 7% pf.	108½	108½	110
No. States Pwr. (Del.), 8% com.	134	123	136½
No. Texas Elec., 6% pf.	55	45	70
No. Texas Elec., com.	16	....	....
OHIO BRASS, com. B $4—no par.	*k*100½	89	100½
Ohio Brass, 6% pf.	*k*107	106	111
Ohio Pwr., 6% pf.	107	104	107½
Ohio Pub. Serv., $6 pf.	103½	95	105
Ohio Pub. Serv., 7% pf.	112½	107	112
Ohio River Edison, 7% pf.	108½	106	109½
Oklahoma Gas & Elec., 7% pf.	114½	106	115½
PACIFIC Gas & ELEC., 6% pf.	29½	26½	29½
Pacific Gas & Elec., 8% new com.	46½	43½	49½
Pacific Pwr. & Lt., 7% pf.	*l*110	106	109½
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 80½	79½	82
Penn-Ohio Edison, 6% pf. no par	95½	93½	96
Penn-Ohio Edison, 7% pf.	108½	106½	109
Penn-Ohio Pwr. & Lt., 7% pf.	110	99	110
Penn Pwr. & Lt.—$7—no par.	*l*110½	109½	110½
Penn Wtr. & Pwr., $2.50 com., new	*e* 70½	68	72½
Phila. Co., 6% pf.—50.	*k* 46	45½	48½
Phila. Co., 6% pf.—50.	56½	52	57
Phila. Co., com.—50.	*k*145	145	163
Phila. Elec., 8% com.—25.	61½	55½	60
Portland Elec. Pwr., 7% pf.	102½	100	104½
Portland Elec. Pwr., 6% pf.	94	78	96
Portland Elec. Pwr., 6% 2d pf.	80	55	88
Portland Elec. Pwr., com.	51	....	....
Potomac Elec. Power, 6% pf.	*f*112½	....	....
Pwr. Sec., pf.—no par.	*k* 65	50	68
Pwr. Sec., com.—no par.	12	5	15
Public Serv. of Colorado, 7% pf.	105	....	....
Pub. Serv. of N. J., 6% pf.	108½	103½	108½
Pub. Serv. of N. J., 7% pf.	121	118	121
Pub. Serv. of N. J., $2 com.—no par	49	41½	49½
Pub. Serv. of No. Ill., 6% pf.	*a*115	110	115
Pub. Serv. of No. Ill., 7% pf.	*a*120	119	121
P. S. of No. Ill., com. $8—no par.	*a*172	159½	180
Pub. Serv. of No. Ill., $8 com.	*a*174	159½	180
Pub. Serv. of Okla., 7% pr. ln.	106½	100	107
Pub. Serv. Elec. & Gas, 6% pf.	*k*110	108	110½
Puget Sound Pwr. & Lt., 7% pf.	109½	109	113
Puget Sound Pwr. & Lt., $6 pf.—no par.	98	96½	99
Puget Sound Pwr. & Lt., com.	58½	29½	63½
RADIO CORP. OF AMER., $3.50 pf.—50.	56½	54½	57½
Radio Corp. of Amer., com.—no par.	195½	85½	196½
Rhode Island Public Service, pf. $2—no par.	*m* 31½	30½	31½
Rochester Gas & Elec. 6% pf. D.	*k*105	105½	106½
Rochester Gas & Elec., 7% pf. B.	107	105	107
Rochester Gas & Elec., 6% pf. C.	105½	105½	106½
SAN JOAQUIN Lt. & Pwr., 7% pr. pf.	116	110	117½
St. Joseph Ry., L., H. & P., 5% pf.	*k* 75	70	75
Servel, Inc.	*k* 6½	4½	7½
Sierra Pacific Elec., 2% com.	35½	29	38½
Sioux City Gas & Elec., 7% pf.	107½	100	108½
Southeastern Pwr. & Lt., pf.—$7 no par.	*k* 109½	....	....
Southeastern Pwr. & Lt., pfc. pf.	*l* 88½	....	....
Southeastern Pwr. & Lt., com.—no par.	47½	40½	48
So. Calif. Edison, 8% pf.	*k* 47	38	41
So. Calif. Edison, 7% pf.	29	27½	29½
So. Calif. Edison, 6% pf.	27½	25½	27½
So. Calif. Edison, 8% com.	45½	43½	48½
Southern Cities Utilities, 7% pf.	*k* 85	75	85
Southwestern Lt. & Pwr., A $3.	80	60	80
Southwestern Lt. & Pwr., B.	65	60	65
Southwestern Lt. & Pwr., $6 pf.	92	88	92½
Southwestern Pwr. & Lt., 7% pf.	*k*112	103	113
Standard Gas & Elec., 8% pf.	68½	65	68½
Standard Gas & Elec., 7% pr. pf.	113½	110½	114½
Standard G. & E., com. $3.50.	63½	57½	66½
Standard Power & Light, com.	40	29½	45
Standard Pwr. & Lt., 7% pf.	107	103½	107
Staten Island Edison, pf.—$6—no par	102½	99	103½
Superheater, $6 com.—no par.	*m*164	162	175
Syracuse Lighting, 7% pf.	110	103	111
Syracuse Lighting, 8% pf.	*k*117½	114	119
TAMPA ELEC., com. $2.	68½	62	68½
Tenn. Elec. Pwr., 6% pf.	103½	92	103
Tenn. Elec. Pwr., 7% pf.	108½	107	110
Terre Haute, Ind. & East. Trac., 5% pf.	*k* 10	....	....
Terre Haute, Ind. & East. Trac., com.	*k* 1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*114	113½	115
Tide Water Pwr., 8% pf.	112	108	112
Timken Roller Bear., com.—$4 no par.	124	112½	134
Toledo Edison, 7% pf.	110½	103	115
Toledo Edison, 6% pf.	*k*104½	95	105
Toledo Edison, 6% com.	*k*145	120	150
Tri-City Ry. & Lt., 6% pf.	90	93	102
UNITED GAS & ELEC., 7% pf.	95	98	103
United Gas & Elec. (N. J.), 5% pf.	75	70	77
United Gas Impr., 8% com.—50.	*c*123½	111½	120½
United Lt. & Pwr., pf.—$4—no par.	*k* 55	49	56½
United Lt. & Pwr., pf.—$6.50—no par.	*a*100½	95	101
United L. & P., com. A .48—no par.	*a* 22	14	22
United L. & P., com. B .48—no par.	*a* 29½	19	25
Utah Pwr. & Lt., 7% pf.	*l*111½	109½	112
Utica Gas & Elec., 7% pf.	105½	105	106½
Utica Gas & Elec., 8% com.	*k*200	215	225
Utilities Pwr. & Lt., 7% pf.	101	98	103
Utilities Pwr. & Lt., com. A $2.	31½	28½	34½
Utilities Pwr. & Lt., com. B $1—no par.	23½	18½	26½
VERMONT HYDRO-ELEC., 7% pf.	100	95	102
Virginia Elec. & Pwr., 7% pf.	*k*110½	108	111
Virginia Public Service 7% pf.	101	97	103
WAGNER ELEC., 7% pf.	*b*101	96½	102
Wagner Elec., com.—no par.	*b* 52	37½	55½
Washington Ry. & Elec., 5% com.	470	450	560
Washington Ry. & Elec., 7% pf.	103	....	....
Washington Wtr. Pwr., 8% com.	227	175	235
West Penn Elec., 7% pf.	114	109½	114½
West Penn Elec., Cl. A $7.	*k*110	106½	110½
West Penn Pwr., 7% pf.	116½	117	117
West Penn Pwr., 6% pf.	110½	109½	113
West Virginia Lt., Ht. & Pwr., 7% pf.	95	94	100
Western Pwr., 7% pf.	103	98	105
Western States Gas & Elec., 7% pf.	102	100	106
Western States Gas & Elec., com.	38	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	108	88½	112
Weston Elec. Instrument, Cl. A $2—no par.	33½	30½	34
Weston Elec. Instrument, com.—no par.	17½	12½	17½
Wheeling Elec., 6% pf.	105	95	104
Worthington Pump, 7% pf. A.	*k* 49	46½	55
Worthington Pump, 6% B.	*k* 44½	41	49½
Worthington Pump, com.	29	28	34½
YALE & TOWNE com. $5—25.	70½	68½	75

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, March 31. *l*Bid price Wednesday, April 4. *m*Latest quotations available. †Dividend rate variable.

ELECTRIC POWER & LIGHT PAYS INITIAL DIVIDEND.—Directors of the Electric Power & Light Corporation have declared an initial quarterly dividend of 25 cents per share on the common stock, no-par value, payable May 1 to holders of record April 14.

RECENT LISTINGS.—The New York Stock Exchange has authorized the listing of 5,162 additional shares of common stock, class A, of the General Gas & Electric Corporation, without par value, on official notice of issuance and payment in full, making the total amount applied for 350,909 shares. There have been placed on the Boston Stock Exchange list first mortgage 5 per cent twenty-year gold bonds of the Oklahoma Power & Water Company to the amount of $4,500,000.

HARTFORD ELECTRIC TO REDUCE PAR OF STOCK.—The directors of the Hartford Electric Light Company, Hartford, Conn., met March 27 and voted to recommend to stockholders a par value reduction in stock from $100 to $25. This is advised by the directors to obtain a wider distribution of ownership. At present the capital structure has 180,000 shares, which under the plan would become 720,000 shares. New certificates for shares will be issued as soon as the recommendation is approved by a majority of the stockholders.

TRI-CITY PASSES PREFERRED DIVIDEND.—The Tri-City Railway & Light Company, Davenport, Iowa, has passed the preferred dividend due April 1 this year. The last payment was 1½ per cent, paid Jan. 2.

ELECTRIC VACUUM DECLARES EXTRA DIVIDEND.—The Electric Vacuum Cleaner Company, Inc., declared an extra dividend of $1 in addition to the regular quarterly dividend of $1 a share on the common stock.

BUFFALO, NIAGARA & EASTERN STARTS CONSOLIDATION OF SUBSIDIARIES.—As the first step in consolidating the subsidiaries, stockholders of the Buffalo, Niagara & Eastern Power Corporation, March 19 voted to authorize an issue of 500,000 shares of first preferred stock without par value. The stock will be entitled to cumulative dividends at the rate of $5 a share annually. Plans call for the issuance soon of not more than 350,000 shares of the new stock to acquire by exchange or to provide funds for redemp-

tion of preferred stocks of the Niagara Falls Power Company, Niagara, Lockport & Ontario Power Company and the Tonawanda Power Company, three of the subsidiaries to be consolidated.

PENN CENTRAL SHAREHOLDERS GIVEN RIGHTS.—Holders of $5 series preferred stock of record April 2 will be given the right to subscribe on or before May 6 at $45.50 per share for a new series of preferred shares of no-par value, designated as $2.80 series, to the extent of 15 per cent of their holdings. The unsold portion of the 25,000 shares of $2.80 series preferred stock will be offered to the public at $47 per share.

April Issues Total $94,775,000

Six electric light and power companies issued new securities during the first week in April to the amount of $94,775,000. The American Gas & Electric Company was responsible for $50,000,000 of the total in the form of 5 per cent gold debentures priced at 101 and accrued interest, to yield about 4.95 per cent. Proceeds will be used in connection with the redemption on May 1, 1928, of all of the $46,904,000 6 per cent gold debenture bonds of the company now outstanding with the public. Another sizable offering of 5 per cent gold debentures was made by the New England Power Association, a piece of financing involving a total of $25,000,000.

First and refunding mortgage gold bonds of the Gulf Power Company were offered at 99 and interest, to yield about 5.06 per cent. This issue amounted to $2,500,000. Two new offerings were made by the Central States Edison Company—one in the form of first lien 5½ per cent gold bonds, series A, amounting to $1,350,000, and the other in the form of three-year 5½ per cent convertible gold notes, priced at 98½ and interest, amounting to $675,000.

The North Continent Utilities Corporation issued 12,500 shares of 7 per cent cumulative preferred stock at $100 per share and accrued dividends, proceeds from the sale of which will be used for extensions and betterments.

The Minnesota Power & Light Company made an offering of first and refunding mortgage gold bonds, 4½ per cent series, amounting to $14,000,000, the price being 97¼ and interest, yielding 4.64 per cent. These bonds were dated May 1, 1928, and mature May 1, 1978. Upon completion of this financing there will be $24,700,000 first and refunding mortgage gold bonds and $7,747,000 underlying divisional bonds outstanding.

Utility Offerings in 1928 Total $330,000,000

DURING the first three months of 1928 the electric light and power companies of the country issued new securities to the amount of $330,406,852, as compared with $486,634,000 for the corresponding period of 1927. The month of March contributed $128,301,352 to this total, a figure which indicates an increase of $32,000,000 over March, 1927, and of $25,000,000 over February, the preceding month.

The largest individual offering in March was made by the Engineers Public Service Company in the form of convertible preferred stock, a piece of financing involving a total of $32,000,000. Proceeds will be used to retire the 311,662 shares of $7 dividend preferred stock. Engineers Public Service was not the only utility that took advantage of favorable conditions to replace old issues bearing high interest rates with new issues yielding lower returns. The Iowa Power & Light 4½ per cent issue replaced 6 per cent and 5½ per cent bonds; Utah Power & Light's five-and-a-half-million-dollar issue replaced a similar amount of 6s outstanding; proceeds from the twenty-three-million-dollar issue of the Metropolitan Edison Company retired various 5 and 6 per cent issues and the Memphis Power & Light offering of 4½ per cent bonds refunded a 6 per cent issue.

With the exception of one small issue the new financing was all of a long-term nature. The average yield dropped to 5.09 per cent in March.

Security Issues of Electric Service Companies in March

Name of Company	Amount of Issue (Par Value)	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Rochester Gas & Electric Corp.	$6,000,000	49	General mortgage gold bonds, series D	To reimburse for cost of extensions and additions	4½	99½	4.52
Interstate Public Service Co.	12,554,000	30	First mortgage and refunding gold bonds, series F	To reimburse for refunding bonds and for other corporate purposes	4½	94½	4.85
Oklahoma Power & Water Co.	4,500,000	20	First mortgage gold bonds, series A.	To provide a part of the purchase price of properties acquired	5	96½	5.30
National Power & Light Co.	10,314,852	..	Cumulative preferred stock	General corporate purposes	6	102	5.88
Iowa Power & Light Co.	6,000,000	30	First mortgage gold bonds, series A	To retire bonds, for additions and extensions and for other corporate purposes	4½	95¼	4.80
San Antonio Public Service Co.	7,500,000	30	First mortgage and refunding gold bonds, series B	To finance acquisition of new properties and to reimburse company for other capital expenditures	5	97½	5.16
Utah Power & Light Co.	5,500,000	16	First lien and general mortgage gold bonds	To retire bonds	4½	96½	4.79
Metropolitan Edison Co.	23,000,000	40	First mortgage gold bonds, series D.	To retire bonds bearing higher rates of interest and for additions and betterments	4½	99½	4.52
Memphis Power & Light Co.	2,275,000	50	First and refunding mortgage gold bonds, series C	To retire bonds	4½	96¼	4.70
Orange & Rockland Electric Co.	1,250,000	30	First mortgage gold bonds	To retire all present outstanding bonds and notes, to reimburse for expenditures on construction and for other corporate purposes	5	99½	5.03
United Public Utilities Co.	3,750,000	19	First lien gold bonds, series B	To acquire securities of subsidiaries	5½	97½	5.70
	3,307,500	..	Preferred stock		6	94½	6.35
American Commonwealths Power Corp.	4,750,000	..	First preferred stock	To acquire stocks of other companies and for other corporate purposes	6½	95	6.85
Engineers Public Service Co.	32,000,000	..	Convertible preferred stock	To retire preferred stock	5	100	5
Iowa Public Service Co.	1,500,000	40	Gold debentures	For acquisition of stock of another utility and for other corporate purposes	5	95	5.30
North Continent Utilities Corp.	3,500,000	20	First collateral lien and refunding gold bonds, series A.	To retire outstanding bonds or to reimburse for expenditures on additions and improvements already made and for other corporate purposes	5½	97	5.75
Great Western Utilities Corp.	600,000	5	First lien and collateral trust gold bonds, series A	Acquisition of properties, to retire indebtedness and for other corporate purposes	6	100	6
Total	$128,301,352			Rights	$32,595,000		
Total amount actually realised	126,088,078			Total financing for March	$158,683,078		

Business News and Market Conditions

Underwriters Report on Armored Cable

A. R. Small, vice-president the Underwriters' Laboratories, New York City, has issued a report covering the work of the Laboratories on armored cable to determine the various properties of armored cable using the new standard of 0.025 in. for thickness of strip instead of 0.034 in. as previously. The report is as follows:

The manufacturers of armored cable have approved in principle the recommendations of the report of Underwriters' Laboratories made as a result of research undertaken at their instance and request, pursued for upward of a year. The object of this research was to determine the various electrical and physical properties of armored cables in relation to the use of the product under the conditions of the National Electrical Code.

In addition to laboratory work, the research included studies, at the factories of all producers, of machines, equipment and methods in the manufacture, test and packing for shipment, and extensive studies in the field of contractors' practices in the installation and use of the product. This latter phase of the research, together with the provisions of the National Electrical Code, provided the basis for determining what are the necessary and desirable electrical and physical properties of armored cable.

Various determinations reached are judged of especial interest at this time, viz., the thickness of strip and the conductivity or, inversely, the resistance, in runs of the cable and at outlet fitting connections. The detailed results of tests described in the report covering the physical properties of resistance to tension and crushing loads give conclusive evidence of acceptable values in these properties of the product to the industry as a whole. These results seem to dispose of the questions raised in the minds of inspection authorities and of contractors covering the new standard for thickness of strip of 0.025 in. instead of 0.034 in. in effect prior to 1925.

In laboratory tests many samples representative of all makes and designs of armored cable were subjected to electrical burnout and overload current tests to determine the characteristic performance when abnormal conditions exceeding those contemplated in the National Electrical Code rules were imposed. The report shows that cable made of 0.025 strip does not convey fire to the outside when burnouts of conductors take place with the conductors loaded up to 100 per cent in excess of National Electrical Code standard fusing for the circuits involved.

Determinations of resistance and conductivity developed the interesting point that over-heating, when carrying grounding currents, would not occur with loads greatly in excess of those appropriate for the fusing of the circuits, and, further, that the actual conductivity of the metal strip of armor varied according to the attitude of the armor as installed; at bends or when the cable was in other than the lying-straight position the resistance dropped to values much less than obtained when specimens were lying straight. This phenomenon is due to the contacts made by the edges of the strip in the convolutions which form the armor with the surface of the adjoining strip. These contacts are better electrically on account of the pressure produced by the curved attitude of the armoring.

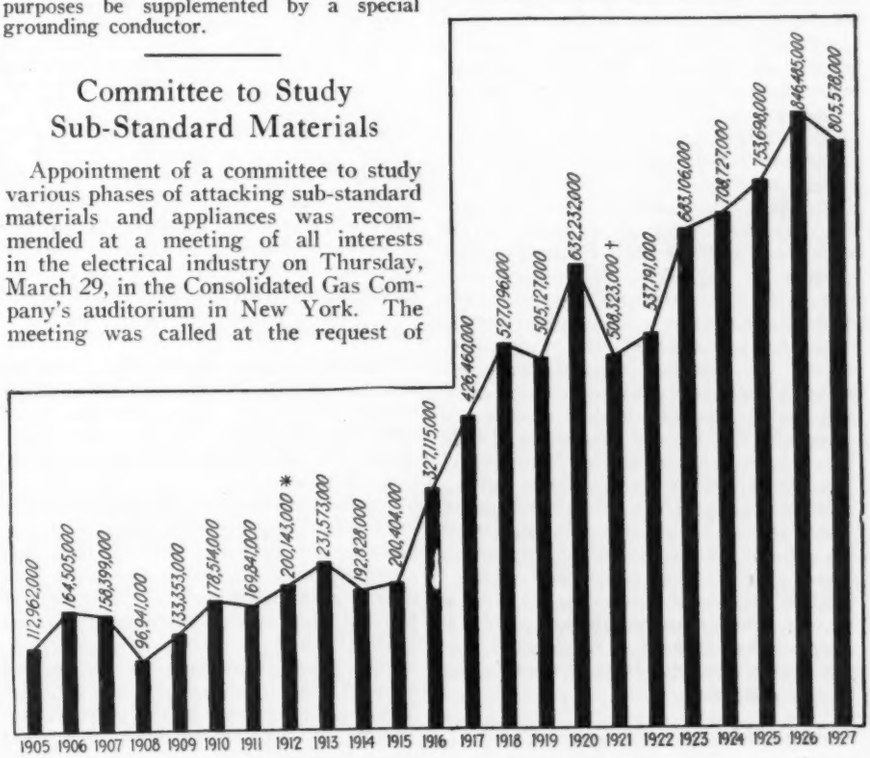
It was shown that it will be feasible to specify and obtain such a maximum value for resistance of armor when in the lying-straight position as to produce no dangerous rise in temperature in the metal when it is called upon to carry grounding currents much in excess of those for which the circuit wires are properly fused. All manufacturers in the industry are now co-operating with the staff of the laboratories relative to the installation of equipment and test methods to control this factor on the entire output.

The report thoroughly disposed of questions which have been raised concerning the resistance of connections at outlet fittings. All usual makes and types of terminal fittings with different standard makes and types of outlet boxes were tested with various combinations and sizes of standard armored cable. In general, the data of the report show that the resistance across an outlet including two fittings is no greater than the resistance of a run of 6 in. of the cable itself. These results were the considerations leading the committee on wiring methods (article 5 of the National Electrical Code) to take no action on the proposed recommendation that the conductivity and reliability of connections of armored cable for protective grounding purposes be supplemented by a special grounding conductor.

Committee to Study Sub-Standard Materials

Appointment of a committee to study various phases of attacking sub-standard materials and appliances was recommended at a meeting of all interests in the electrical industry on Thursday, March 29, in the Consolidated Gas Company's auditorium in New York. The meeting was called at the request of various interests by the Electrical Board of Trade of New York, Inc., whose chairman, Charles L. Eidlitz, opened the meeting and turned over the chair to T. H. Joseph, who called on various members to offer their suggestions. Reinspection of installations was suggested as one way to stop the use of non-approved material, but J. C. Forsyth of the New York Board of Fire Underwriters said the cost was prohibitive. H. R. Sargent, speaking for the manufacturers, said that while some manufacturers were for quality and approved material only it was impossible to control the production and standards of all the manufacturers. Harry Kirkland of the Society for Electrical Development referred to the city ordinances of Portland, Ore., and Louisville, Ky., where none but approved material could be offered for sale. In discussing the passage of a similar ordinance in New York City objection was made by representatives from adjoining territories in Long Island, New Jersey and Westchester County, who said that a local ordinance would have the effect of dumping the non-approved products in

Trend of Electrical Sales



COMBINED ELECTRICAL SALES OF ALLIS-CHALMERS MANUFACTURING COMPANY, CROCKER-WHEELER ELECTRIC MANUFACTURING COMPANY, GENERAL ELECTRIC COMPANY, GRAYBAR ELECTRIC COMPANY, WESTERN ELECTRIC COMPANY AND WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

(a) Munitions sales during the war years and non-electrical sales not included.

(b) Sales of any one of the companies do not include purchases from any of the other companies listed.

*Fort Wayne, Sprague and National added to General Electric sales.

†Southwest General Electric added and International General Electric omitted from General Electric sales.

their respective localities. It was suggested that relief be sought through State legislation. Whether to remedy the situation through State legislation, label registration, complete fire insurance inspection or some other way will be determined by a committee which will represent all branches of the industry.

N.E.M.A. Develops Code of Business Conduct

Through its board of governors the National Electrical Manufacturers' Association has indorsed a code of business conduct. This code, as developed by the committee on code of ethical and sound merchandising principles, was presented to the policies division meeting in Chicago by N. A. Wolcott, chairman of the committee, and will appear shortly in printed form. The more specific portions of the code are as follows:

The electrical manufacturers indorse the principle of a one-price policy.

A request for competitive prices on the part of a buyer involves definite obligations toward all bidders. The electrical manufacturers indorse as in the interest of sound, ethical and economic relations between buyer and seller the following principles to apply to competitive bidding under any specific inquiry:

That the bids be considered as confidential information between buyer and bidder until all bids are in and the buyer has placed the business.

That bidders exchange, where practicable, full information regarding their bids after the business is placed.

Where specifications call for various items involving different types and classes of apparatus, the relative merit of the different bids is best determined and freedom of choice on the part of the buyer promoted if each bidder quotes segregated prices at which any individual item would be accepted.

Market Conditions

STEADY buying of general supplies is reported in the New England district. Orders for heavy industrial equipment and central-station supplies are predicted for the coming months, though at present the market is quiet. Building supplies are in good demand. In the Eastern district satisfactory sales continue. A New York power company placed an order for $300,000 worth of substation apparatus. There is an increasing number of new prospects now in the market for motor equipment. A manufacturer of appliances reports excellent business.

In the Southeast the industrial field is active. A textile plant in Tennessee purchased considerable equipment, including a 3,000-kw. turbo-generator; two 1,500-kw. turbines also were ordered for the use of tobacco plants in the Carolinas, and a tannery in Georgia purchased 31 motors. The demand for building materials is steady in St. Louis, and good sales of electric ranges are reported. March business in the Middle West improved over that of January and February. On the Pacific Coast buying by industrial plants is active. A paper plant at Grays Harbor, Wash., purchased $30,000 worth of equipment, a paper plant at Port Townsend ordered $10,000 worth of transformers and a Nevada mining company bought $17,500 worth of equipment. A decided improvement in motor sales is reported by Seattle concerns.

Lead Sales Active—Little Copper Buying Recorded

The only metal in the non-ferrous group that enjoyed an active market is lead. Buying was particularly brisk at the higher prices established on Monday. Following a phenomenally big week from the standpoint of volume of sales the copper market quieted down and sales have been very light. Zinc continues dull, though prices are a little better. Tin is inactive with little net change in prices.

NEW YORK METAL MARKET PRICES

	Mar. 28, 1928 Cents per Pound	April 4, 1928 Cents per Pound
Copper, electrolytic	13 90	14 0
Lead, Am. S. & R. price	6	6.10
Antimony	9¼	9¼
Nickel, ingot	35	35
Zinc spots	6.046	6.075
Tin, Straits	53	53¼
Aluminum, 99 per cent	24.30	24.30

Base copper wire price April 4, 1928, 16 cents.

New England Sales Continue at Steady Rate

Sales of general supplies is in steady volume in the New England district. Orders for heavy industrial equipment and central-station supplies are predicted for the coming months, though at present the market is quiet. Small-motor sales are normal. Orders recently have been received for motors to replace group drive in several factories, among which are noted two shoe factories in southern New Hampshire and a prominent rubber factory in eastern Massachusetts.

New construction supplies are in good demand. With a large amount of new building to be done in the district, the volume of supplies to meet this need gives promise of showing a marked increase over that of last year. Wire, wiring devices, cable and conduit are moving steadily, outside work is advancing, floodlighting systems are receiving attention, and street-lighting projects are progressing. A plan has been proposed to establish a "whiteway" in Haverhill, Mass. Electric heating furnace sales are encouraging. A prominent manufacturer reports for the first quarter sales of seventeen pot furnaces, four box type units and three special types, aggregating about 750 kw. The Holyoke Water Power Company has received permission from the War Department to build a hydro-electric plant and plans have been prepared for a development of 40,000 hp. from four units. The United States Finishing Company, Providence, R. I., plans an addition to its textile mill, to cost $100,000.

Industrial Field Active in Southeast

Such activity as is noted in the Southeast is in the industrial field. Central-station buying is considerably off. Contracts were let in connection with a textile plant in Tennessee and orders were placed for a 3,000-kw. turbo-generator and auxiliary equipment, $125,000 worth of wiring supplies, and oil circuit breakers amounting to $12,000. A switchboard order for $30,000 was recently placed in connection with the same textile plant. A small turbine and motor equipment were purchased by a Carolina textile plant at a cost of approximately $20,000. Two 1,500-kw. turbines also were ordered for use of tobacco plants in the Carolinas. A tannery in Georgia ordered 31 motors aggregating 465 hp. for use in a rebuilt plant. Building contracts which will be let in a few days include one for a silk mill in Tennessee, the electrical materials on which will approximate $15,000, and another on a bleachery in South Carolina, wiring materials transformers and motor equipment on which will be about $30,000.

The Georgia Power Company has purchased the privately owned distribution system at Lyerly and will extend its 38,000-volt transmission line a distance of 7 miles and will install a 150-kva. transformer substation to serve that town. The Georgia Power Company also has purchased the municipally owned distribution system in Bowman and will install a 150-kva. transformer substation and revamp the system for three-phase operation.

Construction news is as follows: The Southeast Power Company has acquired the municipal power plant at Nashville, Ga., and plans installation of Diesel engine-generator and other equipment. The Mississippi Power & Light Company will install a distribution system at Myrtle, Miss. The Chatham Manufacturing Company, Elkin, N. C., is building an addition to its textile mill to cost $85,000. The Duke Power Company plans a substation at Marion, N. C., to cost $50,000. The Cleveland Cloth Mills Company, Shelby, N. C., will build an addition to cost $200,000.

The Chilhowee Mills Company, Athens, Tenn., will build an addition to its textile mill, to cost $70,000. The Dixie Stock Yards, Memphis, Tenn., plan a packing plant to cost $100,000. The Virginia Electric & Power Com-

pany plans a substation at Norfolk, Va., to cost $250,000. The Central Atlantic Service Corporation, 20 Broad Street, New York, plans an ice plant at Pulaski, Va., to cost $100,000. The Carolina Power & Light Company has authorized surveys for a transmission line from Sanford to Broadway, N. C. The Southern Public Utilities Company will build a transmission line to Walnut Cove, N. C. The Tennessee Electric Power Company plans a transmission line from Nashville, Tenn., to Muscle Shoals, to cost $700,000. The Northern Virginia Power Company plans a transmission line to Kabletown, W. Va. Montgomery, Ala., and Pineville, W. Va., will install street-lighting systems.

Satisfactory Sales Continue in Eastern District

Both central-station and industrial business continue active in the Eastern district. While orders are on a reduced basis, the gross volume of transactions compares favorably with sales for the same period last year. A New York power company has placed an order for substation apparatus amounting to about $300,000, while a New Jersey utility has been active in ordering substation and switching equipment. Northern New York power interests are becoming more noticeable in the market, and with comparatively small sales from this quarter up to the present time it is expected that satisfactory business will ensue. A Connecticut central-station company has been making purchases of transformers, switching apparatus and other substation equipment to a total of $90,000, and the demand is growing stronger from utilities in that section. Increasing industrial activity in certain lines is leading to corresponding advance in electrical equipment orders. There is a healthy tone to the growing inquiries for motors and kindred apparatus for paper mills, chemical plants, iron and steel works, and textile mills. A leading manufacturer of industrial motors comments upon the increasing number of new prospects now in the market for equipment, with each week developing a sizable quota of such account. Sales of automatic timing switches for plant service also show improvement. A manufacturer of sewing machines in New Jersey has placed an order for control and kindred apparatus with a prominent maker to an amount of $20,000. A paper mill has asked bids on a complete line of equipment for a new plant at Tacoma, Wash., and will soon place contracts. A chemical company at Syracuse, N. Y., is making commitments for a plant at Hopewell, Va. Another such concern at New York will purchase a considerable amount of equipment, including electric cranes, for a synthetic gypsum plant at Tampa, Fla. Newark, N. J., has asked bids for a signal system to cost about $25,000.

A prominent manufacturer of electric appliances reports excellent business in that line, with sales records for the first quarter of 1928 exceeding the figures for the corresponding period or for any other quarter of last year. Jobbers have been active purchasers, with particularly heavy demand from this quarter at Philadelphia and Harrisburg, Pa. Electric elevator business is decidedly good in the metropolitan district at the present time, with inquiries indicating continuance. The call for electric welding apparatus has been lagging for several weeks, but early revival is in sight. Electric railway business continues to show improvement. New York subways are expected to be in the market for motor apparatus for the new Flushing, L. I., extension at an early date. Business with steam railroads is on a reduced basis. Wire and cable sales have been at a low point, but current inquiries point to more sizable commitments within a short time.

Construction activities in the Eastern district include the following: The Bronx Gas & Electric Company plans a substation on Laconia Avenue to cost $100,000. The New York Central Railroad Company is asking bids until April 13 for railway motors and multiple-unit control equipment. The Signal Corps Procurement District, Governors Island, will receive bids until April 12 for 24 lightning switches (Circular 140). The Public Service Electric & Gas Company plans a switching station at Metuchen, N. J., and a substation at Princeton, N. J. The Great Lakes Portland Cement Company, Buffalo, N. Y., plans a mill near Cleveland, to cost $1,000,000. The Bethlehem Shipbuilding Corporation, Baltimore, Md., will construct an addition to cost $1,800,000. The Southern Light & Power Company has purchased the Millington Electric Light & Power Company, Millington, Md., and will build transmission lines in Queen Anne County. Patapsco Power, Light & Mineral Company, Marriottsville, Md., plans a feldspar mining mill to cost about $85,000. The United States Engineer, Pittsburgh, Pa., will receive bids until April 11 for two hydraulic turbines (Circular 358). The Board of District Commissioners, Washington, D. C., is asking bids until April 12 for six transformers for the new McKinley technical high school. The General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until April 19 for electric fans, etc. (Panama Schedule 1869).

March Business Improved in Middle West

March business in the Middle West improved over that of January and February. Sales during the first quarter of the year were not quite up to the expectations expressed at the beginning of the year. Apparently there is no room for apprehension as to conditions. Building activity is getting under way. Utility companies continue active in construction work. An order placed for the construction of a substation amounted to $50,000, and another order called for 46 distribution transformers from 37½ kva. to 450 kva. Jobbers' sales are normal. Considerable municipal business is being obtained and sales are expected to improve.

Construction projects are as follows: The Udell Printing Company, Chicago, plans a new plant to cost $300,000. The Consolidated Sign Company, Battle Creek, Mich., plans a new plant to cost $100,000. The Kalamazoo Vegetable Parchment Company, Kalamazoo, Mich., plans an addition to cost $900,000. The Consumers Power Company, Jackson, Mich., plans a 35,000-hp. hydro-electric plant in the Mecosta-Newaygo district, to cost $1,500,000. The Michigan Rubber Company, Owosso, Mich., plans an addition to cost $100,000. Montpelier, N. D., plans a light and power system to be furnished by the Otter Tail Power Company. Christ Hospital, Cincinnati, Ohio, plans a power plant and laundry, to cost $350,000. Sioux Falls, S. D., is arranging bonds for $100,000, for improvements in its municipal power plant. The Modine Manufacturing Company, Racine, Wis., plans an addition to its automobile radiator plant, to cost $100,000. Cedar Rapids and Jewell, Iowa, and Neenah, Wis., plan ornamental lighting systems.

Buying by Industrial Plants Active on Pacific Coast

Industrial plant buying marked the activity on the Pacific Coast. Such orders as two 1,000-kva. control switchboards, totaling $30,000, for a paper plant at Grays Harbor, Wash., power transformers totaling $10,000, for a Port Townsend paper plant, $4,000 worth of synchronous motors for ice machine service, a 187-kva. waterwheel generator, valued at $3,500, for the porcelain plant of a spark plug manufacturer, a 125-hp. slow-speed synchronous motor, valued at $4,500, for a cement mill, and a 200-hp. synchronous motor, valued at $2,500, for a Nevada mining company. Another Nevada mining company ordered two storage battery General Electric locomotives, which, with nine transformers, 150 kva. and 200 kva., motor-generator set, lightning arresters and accessories, comprises an order totaling $17,500. Mining business is indeed brisk. Orders include $2,000 worth of wiring material for a gold dredger, a similar assortment for Alaska mines, and a large shipment to Mexico comprising 30 motors from 3 hp. to 75 hp. and three 75-kva. transformers, totaling $12,000. Power company orders have included one carload of 10-kv. pin-type insulators, valued at $5,000, for the Fresno district, $3,000 worth of weatherproof wire, $1,000 worth of hardware for the Turlock irrigation area, and 200 ranges, valued at $20,000, principally for the Tulare and northern California areas.

A decided improvement in motor sales is reported by Seattle concerns and includes 50 machines, from 125 hp. down, to a pulp and paper mill in the Grays Harbor district, 25, from 30 hp. down, to a pulp mill in Bellingham, and approximately 100 small motors from 15 hp. down, mainly for irrigation and orchards and the remainder divided between wood-

working and industrial sources. The city of Seattle is expected to call for bids for furnishing and installing network protectors and cable material to cost about $200,000 including installation. An ordinance is before the Bremerton city council providing for the installation of a street lighting system to cost about $22,000.

Construction projects are as follows: The Pacific Fruit Express Company, San Francisco, will build a refrigerator car repair shop at Tucson, Ariz., to cost $225,000. Los Angeles plans a substation at Venice, to cost $80,000. The Western Oil & Refining Company, Martinez, Calif., plans a new plant to cost $350,000. The Mechow-Pateros Growers Association, Pateros, Wash., plans a cold storage plant to cost $90,000. The Wenatchee Produce Company, Wenatchee, Wash., plans a cold storage plant to cost $100,000. The Great Northern Railway Company, St. Paul, Minn., plans a repair shop for electric locomotives at Wenatchee, Wash., to cost $100,000. The Puget Sound Power & Light Company, Seattle, Wash., plans transmission lines in Louis County, to cost $80,000. Montesano, Wash., will install ornamental lighting system. The British Columbia Electric Power & Light Company, Victoria, B. C., plans a distribution station to cost $250,000.

Building Material Demand Steady in St. Louis

Important orders in the St. Louis district include four motors, amounting to $6,000 for the oil district, substation equipment for southern Illinois amounting to $35,000, and four generators, to cost $10,000, for connection with Diesel engines. Jobbers and retail dealers report business in building and line construction materials holding up to last year's level, also a good demand for electric ranges.

Construction projects are as follows: The Varnell Lumber Company, Hampton, Ark., plans a local power plant and system. The Kansas State Industrial Reformatory, Hutchinson, Kan., plans an addition to power plant to cost $50,000. The Waxide Paper Company, Kansas City, Mo., plans a mill at St. Louis, to cost $250,000. The Kansas City Fibre Box Company, Kansas City, Mo., plans an addition to cost $750,000. The Great Atlantic & Pacific Tea Company, New York, plans a baking plant at St. Louis, to cost $650,000. The B. F. Goodrich Company, Akron, Ohio, plans a factory branch and distributing plant at St. Louis, to cost $100,000. The Great Plains Mill & Elevator Company, Enid, Okla., plans a new flour mill, to cost $200,000. The Syndicate Power Company, Abilene, Tex., plans a hydroelectric plant on the Colorado River. The San Antonio Tanning Company, San Antonio, Tex., plans a plant to cost $100,000. The Ewauna Box Company, Klamath Falls, Ore., plans a branch mill at San Benito, Tex., to cost $200,000. Amite, La., Muskogee, Okla., and Bossier City, La., plan ornamental lighting systems.

Activities of the Trade

Standard Underground Makes Organization Changes

A. B. Saurman, formerly vice-president and general sales manager of the Standard Underground Cable Company, Division of General Cable Corporation, Pittsburgh, has been made vice-president and consulting general sales manager and will continue his headquarters at the general offices in Pittsburgh, upon his return from the South, where he has been for some time on account of ill-health. Harold P. Childs has been made general sales manager. Mr. Childs was formerly vice-president in charge of sales and advertising for the Servel Corporation and previous to that served with the General Electric Company in the executive office under Anson Burchard, vice-chairman of the board, and J. R. Lovejoy, vice-president.

Hydroil Sales Corporation Changes Name

The Hydroil Sales Corporation of Lebanon, Ind., having purchased a factory and broadened its operation to include manufacturing as well as engineering and selling, has changed its name to the Hydroil Corporation. The company in making this change felt that the new name conveys a more complete understanding of its operation.

Celoron Company Builds New Laboratory

A new laboratory has just been completed by the Celoron Company, division of the Diamond State Fibre Company, Bridgeport, Pa. The company manufactures virtually all its own raw material, making its own paper, resins, etc. The new laboratory has been equipped with facilities for making electrical, physical and chemical tests on its products both during the process of manufacture and as a finished article, and also for doing research work. The laboratory building is a two-story brick structure 42 ft. by 53 ft.

Edison Appliance Appoints Simplex Division Manager

Following the acquisition of the wall outlet appliance business of the Simplex Electric Heating Company, Cambridge, Mass., by the Edison Electric Appliance Company, Inc., Chicago, the Edison company announces that H. K. Dewees will be manager of the Simplex division at 5600 W. Taylor Street, Chicago. Mr. Dewees was formerly assistant appliance division manager of the Edison company. He is succeeded by J. Eugene Armes of the "Hotpoint" appliance sales division of the Edison company. The sale of the wall outlet appliance business of the Simplex company was announced in the Feb. 11, 1928, issue of the ELECTRICAL WORLD.

The Simplex business will retain its own identity and virtually the same sales personnel. All the present appliances in the Simplex line will be continued with the probable addition of some new items in the near future. The nation-wide system of service stations which the Edison Appliance company maintains will be available to all Simplex dealers.

THE ERICSON MANUFACTURING COMPANY, Cleveland, manufacturer of "C & E" safety handles, etc., is now marketing an insulated guard which consists of a metal framework to which the necessary thickness of rubber is added. The guard is primarily for use with the "C & E" safety handle made by the company, but also may be used where any loose guard is required.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that William M. Bradshaw, manager of the meter engineering department, and 39 of his engineers have been transferred from the main plant of the company at East Pittsburgh to the Newark works at Plane and Orange Streets.

THE MARTINDALE ELECTRIC COMPANY, 1260 West Fourth Street, Cleveland, announces its new double-duty commutator stones.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, 115 Broadway, New York City, announces the removal of its executive offices and export and New York district sales department to 2 Park Avenue, New York City, on or about April 1. The company also has moved its head office sales and advertising departments to the Harrison plant of the corporation, located at 421 Worthington Avenue, Harrison, N. J.

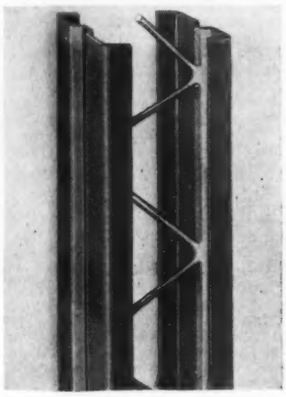
THE IDEAL COMMUTATOR DRESSER COMPANY, Sycamore, Ill., has opened a new branch office at 182 Purchase Street, Boston. New sales representatives recently appointed are as follows: C. B. Keck, Cleveland; F. D. Lawrence Electric Company, Cincinnati; O. T. Hall, Maryland, District of Columbia and the eastern part of Virginia; G. A. Brewer, Connecticut, and De-Moss Fox & Company, Michigan and Toledo, Ohio.

THE DAMPNEY COMPANY OF AMERICA, Hyde Park, Boston, announces that the sale of its "Apexior" protective coatings for power plant equipment will be handled in North Carolina, South Carolina, Florida, Tennessee, Georgia, Alabama, Mississippi and Louisiana by Nevill & Cleary, Inc., Candler Building, Atlanta. The new agents have branch offices in New Orleans and Tampa.

New Equipment Available

Steel Poles

The Truscon copper bearing "Weltrus" steel poles have been placed on the market by the Truscon Steel Company, Youngstown, Ohio. The pole is composed of two channel leg or chord members formed in one continuous length from special sections of copper-bearing steel. These members are connected at suitable intervals by a continuous lattice



Portion of channel member and web section of "Weltrus" steel pole

web member made from plain or round sections, thus forming a simple Warren truss. The web member is autogenously welded by automatic machinery which accurately regulates the time, current and pressure uniformity of each weld. The manufacturers claim that the "Weltrus" pole is a very economical type which will resist a very large transverse load per pound of pole weight, or per dollar of first cost.

Time Switch

A new Sauter time switch with a fourteen-day key-wound clock is being offered by R. W. Cramer & Company, 136 Liberty Street, New York. The clock has a six-jewel lever escapement. Only six full turns of the winding key are needed to wind the spring and the clock is so designed that overwinding is not possible. It is for use on circuits of not more than 15 amp. A cast-aluminum case is used and the case lock can be operated only with the clock-winding key. Every switch undergoes an insulation test of 2,500 volts, although not intended for circuits normally over 250 volts. One type of this switch, the S-15-II-W, can be furnished with a Sunday cut-out.

WELDER TRACTOR COMBINATION.—An improved combination of electric arc welder and Fordson tractor is now offered by the General Electric Company. The principal improvements consist of the substitution of a new type welding equipment and the addition of head and tail lights and a protective cover. This outfit is being marketed direct by the General Electric Company. The older outfits utilized General Electric welding equipment but were not sold by that company.

INDUSTRIAL LIGHTING UNIT. — The "Factrolite" unit, an RLM dome with adjustable features, has been placed on the market by the Bryant Park Electric Lamp Company, 330 West 42d Street, New York. The unit consists of an ivory-enameled aluminum reflector, translucent glass diffuser and adjustable aluminum holder which will permit correct focusing for any lamp from 100 watts to 500 watts. By using a wire holder and a metal or glass diffuser disk the reflector may be suspended in an upside down position for indirect or semi-indirect lighting.

Arc Welder

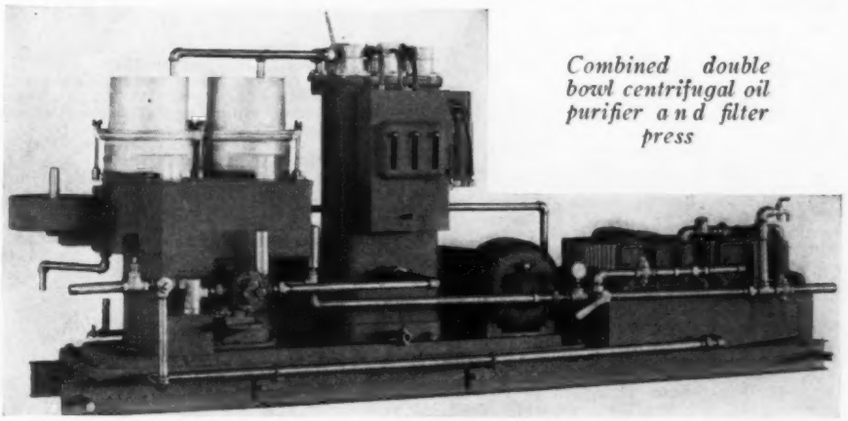
A new 200-amp. single-operator welding set, designed to meet every requirement in both the shop and field, has been developed by the Westinghouse Electric & Manufacturing Company. The set is started by connecting directly across the line. A single rheostat varies the arc current over the entire welding range. Accurate adjustment over the welding range, from 60 amp. to 300 amp., is afforded by steps of 5 amp. The motor-generator and control equipment are assembled in a totally inclosed frame. The exciter, which is overhung from the motor end, is securely fastened to the unit frame. The set can be operated while suspended at any angle that could possibly be required in any application. The motor is wound for 220 or 440 volts and is assembled with the necessary connections made for operation from a three-phase, 60-cycle circuit. If it is desired to operate the unit from a 440-volt, three-phase, 60-cycle circuit it is only necessary to replace the operating coil on the magnetic starter and to reconnect the motor leads.

Transformer for Post-Top Mounting

A new form of street-lighting transformer especially constructed for mounting on the top of a trolley pole has been designed by the General Electric Company. The new design simplifies the installation problem by eliminating the necessity of drilling the pole for the secondary leads. A support just below the top of the transformer carries insulators to which are dead-ended the street-lighting cable. The primary leads are connected to these, while the secondary leads go through the pole and out into the units through the brackets, thus leaving no exposed wires.

Oil Purifier

A large-capacity oil purifying machine, the F-100, has been placed on the market by the Hydroil Corporation of Lebanon, Ind. In basic principle the large capacity machine is similar to the smaller Hydroil machine but uses twin bowls, goes through a heater which oil, before it passes into the centrifugal bowls, passes through a heater which raises the temperature to the point at which the impurities are most easily separated out. Twin bowls are employed to keep the diameter of each bowl small, thus giving high centrifugal separation efficiency and the large capacity needed by present-day large power stations. After the oil leaves the bowl, it passes through a pressure settling tank, where all air is separated from the oil. It then passes through a twin filter press. This filter is so designed that one-half of the twin press only is in operation at any one time.



Combined double bowl centrifugal oil purifier and filter press

All the dirt, water and sludge is removed by centrifugal separation, while the filter press removes the fine particles of carbon that cannot be separated by centrifugal force.

After the oil has passed through the filter press, it can be passed through a continuous test chamber. The test chamber can be so connected with a relay and by-pass valve that only oil of the desired dielectric strength can pass through to the switch tank, transformer or storage tank. The machine is made in stationary and portable models and in combinations to suit any condition.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 13, 1928)

1,662,446. METAL FOIL ELECTRODE; R. H. Wappler, Yonkers, N. Y. App. filed Jan. 14, 1924. Suitable for use in supplying electric currents to the skin of a patient.

1,662,508. ALTERNATING-CURRENT MOTOR; S. G. Nottage, Murraysville, Pa. App. filed March 13, 1924. Phase-converting apparatus.

1,662,548. TESTING DEVICE; H. R. Van Deventer, New York, N. Y. App. filed Feb. 14, 1924. Which may be used to make tests to discover the nature and location of trouble in electrical circuits as induction coils, lighting circuits, motor or generator armatures, fuses, relays, and various types of wiring.

1,662,549. METHOD OF SPEED REGULATION FOR POLYPHASE INDUCTION MOTORS; K. von Kando, Budapest, Hungary. App. filed Feb. 28, 1922. By means of changing the pole connections and employing all the coils of the winding in each arrangement.

1,622,555. UNIVERSAL BOTTLE HEATER; E. Wojciechowski, Aberdeen, Wash. App. filed Dec. 18, 1926.

1,622,556. THERMOSTATIC CONTROL DEVICE; J. C. Woodson, East Pittsburgh, Pa. App. filed June 23, 1926.

1,622,559. REGULATOR SYSTEM; J. H. Ashbaugh, Pittsburgh, Pa. App. filed Dec. 4, 1924. Means for extending the range of operation of vibratory regulator systems.

1,622,677. ROTARY RELAY; C. F. Jenkins, Washington, D. C. App. filed July 21, 1924. For controlling the speed of distant motors, and has for its particular object means for controlling motor speeds by radio.

1,622,697. TIME SWITCH; J. Clifton, J. Robinson and J. Spencer, London, England. App. filed May 5, 1922.

1,622,746. ELECTRIC SUPERHEATER; E. Howe, San Gabriel, Calif. App. filed Feb. 17, 1927. An electric element for boiling water in boilers for producing steam for steam heating.

1,662,771. RESISTANCE UNIT; G. H. Whittingham, Baltimore, Md. App. filed May 8, 1926. Composed of wire coils wound on bodies of refractory material, such as porcelain.

1,662,805. ELECTRICAL STOVE; H. Frank, Hartford, Conn. App. filed July 23, 1926. Portable type.

(Issued March 20, 1928)

16,908 (reissue). DRINK HEATER; J. W. Rittman, J. Rood, and W. Driver, Racine, Wis. App. filed July 28, 1923.

16,912 (reissue). ELECTRIC SWITCH; J. D. Hilliard, Schenectady, N. Y. App. filed Feb. 8, 1921. Oil circuit breaker.

1,662,817. PLUG FOR ELECTRIC CONNECTIONS; A. C. Bollmann, St. Louis, Mo., and W. Davies, Granite City, Ill. App. filed Sept. 28, 1922. As electric irons, toasters, etc.

1,662,822. TERMINAL; M. J. Dunne, West Orange, N. J. App. filed May 2, 1922. For use in welded electrical connections as a rail bond.

1,662,835. ELECTRICAL MEASURING INSTRUMENT; A. R. Rutter, East Pittsburgh, Pa. App. filed March 12, 1926. Watt-meter.

1,662,858. AUTOMATIC CONTROL DEVICE FOR ELECTRIC ARC WELDING APPARATUS; W. R. Hume, Melbourne, Victoria, Australia. App. filed Sept. 21, 1925.

1,662,866. SECONDARY BATTERY OF ACCUMULATOR; E. A. Salazar, Madrid, Spain. App. filed Dec. 14, 1925.

1,662,881. ARMATURE WINDING MACHINE; P. E. Chapman, St. Louis, Mo. App. filed March 22, 1924.

1,662,889. ELECTRIC CONVERTER; A. S. Hubbard, New York, N. Y. App. filed Dec. 6, 1922.

1,662,920. OPERATING MECHANISM FOR TIMEPIECES; N. D. Holbrook, Thomaston, Conn. App. filed Sept. 2, 1926.

1,662,935. ELECTRIC STEAM RADIATOR; J. B. Odell, Riverside, Calif. App. filed June 6, 1927.

1,662,970. SAFETY DEVICE FOR ELECTRIC LINES; C. Grosse, Berlin-Hermsdorf, Germany. App. filed June 12, 1925. Automatic device for domestic service.

1,662,979. CIRCUIT CLOSER; P. R. Nelson, The United States Army, Fort Totten, N. Y. App. filed May 7, 1927. Granted under the provisions of the Act of March 3, 1883. Used in the operation of submarine mines.

1,662,987. LIGHT SIGNAL; C. S. Snavely, Pittsburgh, Pa. App. filed July 20, 1923.

1,662,988. TRAIN SIGNAL SYSTEM; E. C. Stafford, Philadelphia, Pa. App. filed March 7, 1921.

1,663,005. SOLDERLESS CONNECTER; L. E. Hendee, Milwaukee, Wis. App. filed June 16, 1924.

1,663,007. ELECTRIC CONDUCTOR SUPPORT; E. H. Jacobs, Chicago, Ill. App. filed Jan. 31, 1919.

1,663,011. LINE CONDUCTOR INSULATOR; W. D. Kyle, Milwaukee, Wis. App. filed Sept. 19, 1924. Adapted for attaching conductor wires to buildings.

1,663,013. BATTERY TERMINAL; T. P. Logan, Columbus, Ohio. App. filed May 19, 1924.

1,663,030. CIGAR LIGHTER AND ADVERTISING CABINET; C. J. Underwood and J. A. Underwood, Huntington Beach, Calif. App. filed March 16, 1925.

1,663,062. CAN CAP SOLDERING APPARATUS; A. E. Roe, Oakland, Calif. App. filed March 28, 1927.

1,663,081. SNAP SWITCH; H. Hertzberg, Brooklyn, N. Y. App. filed April 17, 1926.

1,663,086. MEANS FOR INDICATING FREQUENCY CHANGES; M. B. Long, Glen Ridge, N. J. App. filed March 4, 1924.

1,663,113. ELECTRIC SOLDERING DEVICE; S. Clayton, Chicago, Ill. App. filed May 18, 1925. Designed especially for use by jewelers and watch makers.

1,663,137. ELECTRIC SPOT WELDING MACHINE; R. Mack, Berlin-Tempelhof, Germany. App. filed Feb. 20, 1925.

1,663,138. SWITCH OPERATING MECHANISM; C. F. Parker, San Francisco, Calif. App. filed Jan. 28, 1924. Interlocked for controlling two circuits as range and water heater circuits.

1,663,153. POLE SUPPORTING DEVICE; A. W. Bensley, Pawtucket, R. I. App. filed Sept. 22, 1927.

1,663,179. RENEWABLE FUSE; F. J. Roth, New York, N. Y. App. filed Sept. 10, 1926.

1,663,187. MULTIPLE TIMER; T. J. Barrett, Los Angeles, Calif. App. filed May 20, 1925.

1,663,193. STORAGE BATTERY; F. P. Danna, Plaquemine, La. App. filed June 4, 1927.

1,663,200. RESISTANCE WELDING MACHINE; A. Jonsson, Helsingborg, Sweden. App. filed Nov. 10, 1926.

1,663,252. FUSE HOLDER FOR ELECTRICAL CIRCUITS; M. B. Herbrick, Omaha, Neb. App. filed April 3, 1926.

1,663,255. ELECTRIC PIPE HEATER; L. P. Hynes, Albany, N. Y. App. filed Nov. 25, 1924.

1,663,258. ELECTRODE CLAMP; J. W. Meadowcroft, Philadelphia, Pa. App. filed Jan. 31, 1925.

1,663,264. LAMP RETAINER FOR LAMP SOCKETS; D. N. Thompson, Syracuse, N. Y. App. filed Sept. 13, 1922.

1,663,318. ELECTRIC MACHINE; T. Schou and R. L. Behrens, Mansfield, Ohio. App. filed June 4, 1923.

1,663,325. AUTOMATIC SWITCH MECHANISM; C. H. Wolff, St. Louis, Mo. App. filed Jan. 18, 1926. For opening the circuit of the split-phase winding of a single-phase motor when a suitable speed has been attained.

1,663,333. FUSE; J. H. Carmean, Kansas City, Mo. App. filed Nov. 2, 1925. Adapted to function by absorption of heat from external sources.

Information on foreign patents can be obtained through the nearest district office of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

A sole agency is desired in Amsterdam, Netherlands (No. 30,463), for electric advertising novelties.

An agency is desired in Alexandria, Egypt (No. 30,365), for household electrical equipment, domestic appliances and wiring supplies.

Any manufacturer desiring to establish agencies abroad may consult with the nearest district office of the Bureau of Foreign and Domestic Commerce, Department of Commerce, where data on available agencies throughout the world are on file.

New Trade Literature

TIME SWITCHES. — R. W. Cramer & Company, 136 Liberty Street, New York City, has issued bulletin F, in which it describes and illustrates the Sauter type S-15-II electric time switches. Wiring diagrams show the application of the switch to a two wire or three wire system.

SOLDERLESS CONNECTORS. — The Delta-Star Electric Company, 2400 Block Fulton Street, Chicago, Ill., has issued a bulletin covering its rigid stud compression type solderless connectors.

FUSED SWITCH.—The W. N. Matthews Corporation, 3722 Forest Park Boulevard, St. Louis, has issued a price sheet covering the No. 1317 open type Matthews "Fuswitch" with a rating of 100 amp. and 7,500 volts.

STEAM GENERATION.—The Combustion Engineering Corporation, 200 Madison Avenue, New York City, is distributing a booklet entitled "Recent Developments in Steam Generation," presented before the Engineers' Society of Western Pennsylvania of Pittsburgh, Pa., by George T. Ladd, president of the Ladd Water Tube Boiler Company. This booklet summarizes the important developments that have occurred in the field of steam generation during the past decade and discusses present trends.

ELECTRIC RANGE.—"A Complete Summer Sales Plan for the Willwear Walloutlet Electric Range" is the title of a folder prepared by the Beardsley Manufacturing Company, Waterbury, Conn. It contains booklets and pamphlets for distribution and posters for display signs, etc.

ELECTRIC APPARATUS.—The General Electric Company, Schenectady, N. Y., is distributing bulletin GEA-916, describing its electric apparatus such as motor-generators, transformers, synchronous motors, induction regulators and rectifying equipment for use with the Cottrell precipitation process.

ELECTRIC FURNACES.—Bulletin No. 5 issued by the Ajax Electrothermic Corporation, Ajax Park, Trenton, N. J., describes the new Ajax-Northrup motor generator type furnaces and equipment. The principle of operation is illustrated and described.

POLES.—The MacGillis & Gibbs Company, Milwaukee, is distributing an illustrated booklet describing a trip through one of its cedar pole yards at Minnesota Transfer, Minn. A photograph compares the grading prior to 1925 and since that time to show the improving standards of quality now being maintained.

TRAFFIC SIGNALS.—The Crouse-Hinds Company, Syracuse, N. Y., has issued catalog No. 224 covering its electric traffic signals and control equipment. It contains illustrations showing typical installations and also its various types of lamps, cabinets and mountings. Information signs for pedestal and horizontal bracket type signals are also included.

PORTABLE COMPRESSORS. — The Ingersoll-Rand Company, 11 Broadway, New York City, has issued the sixth edition of its booklet entitled "100 and 1 Ways to Save Money with Portable Compressors." It contains comparative cost data on its portable air compressors and air-operated tools. Figures are presented on a man-hour basis so that they can be applied to local conditions. Tables are included to show the number of tools that any given portable compressor will operate. The book is profusely illustrated with applications of portable air compressors and air-operated tools to various jobs.

ELECTRIC FURNACES.—Bulletin No. 4 issued by the Ajax Electrothermic Corporation, Ajax Park, Trenton, N. J., describes and illustrates the Ajax-Northrup furnaces for small production and experimental laboratory work operated from 3-kva., 15-kva. and 35-kva. frequency converters. The use of the furnace and its principles are described and illustrated. The historical development of the company is included and a chart shows the growth in sales from 1917 to the present time.

MOTORS.—Sterling Electric Motors, Inc., Telegraph Road at Atlantic Boulevard, Los Angeles, is distributing a pamphlet describing the Sterling "Cross-Line" electric motors.

FOOD MIXER. — The Reynolds Electric Company, 2650 West Congress Street, Chicago, is distributing bulletin No. 603 covering the 12 quart mixer suitable for commercial as well as domestic purposes.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

The Trend Toward 115 Volts

WE HAVE heard much, in these recent years, of simplification in manufacture by reducing the excessive number of sizes and styles of certain commodities. In the electrical industry a reduction in the number of different distributing voltages greatly decreases the number of different kinds of lamps required. Complete unification, with one universally adopted value (and the maintaining, in practice, of the actual service voltage at the announced nominal), would result in more uniform operation of appliances, especially heating devices, that now have to perform in some fashion under a variety of conditions.

Complete unification has not yet arrived, but a strong trend toward standardization is evident from a comparison of data on distribution voltages for 1928 with corresponding figures for 1923. These are to be found in the booklet on central-station voltages recently issued by the lamp committee of the National Electric Light Association. Service at 115 volts increased from 38.5 per cent of the total to 58.8 per cent in terms of population served and from 35.6 per cent to 68.2 per cent in terms of number of communities served. Service at 110 volts decreased from 33.6 per cent to 14.8 per cent of the population served, whereas that at 120 volts increased from 11.3 per cent to 20.8 per cent. The drift is therefore distinctly toward standardization at 115 volts, but with a stronger leaning than formerly, or at least a more uniform leaning, toward the next higher voltage step.

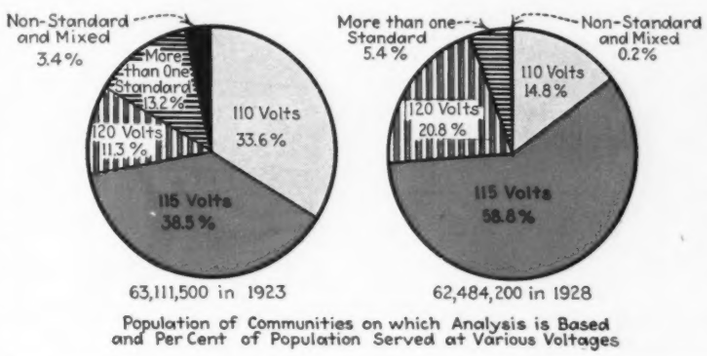
Of equal significance is the reduction in the population served at more than one standard voltage from 13.2 to 5.4 per cent, and the virtual elimination of service at other than the three standard voltages or service at several voltages in the same community.

Even these figures scarcely tell the whole story. Thus, the entire state of New Jersey is served at 115 volts, with the exception of four small communities having either municipal or local private plants, all of which operate at 110 volts.

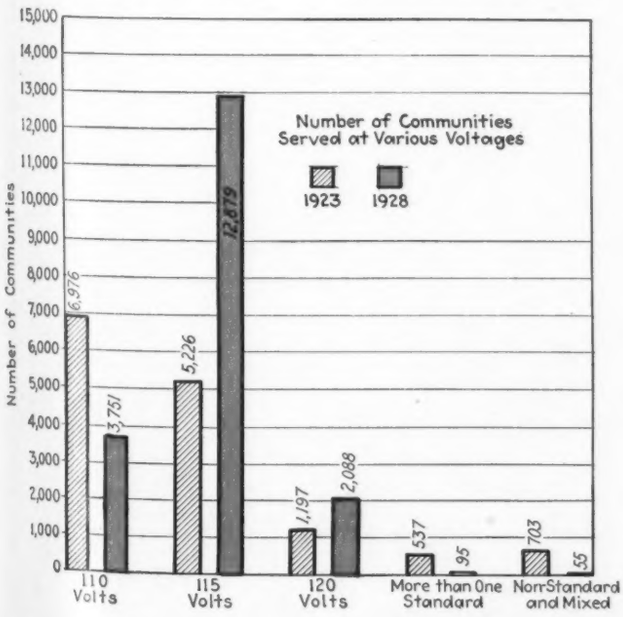
Unification of voltage has apparently been favorably influenced by the consolidation of small operations into larger systems, for with rare exceptions the service voltage in all parts of a given system is the same; in the period of their separate operation that was not necessarily the case.

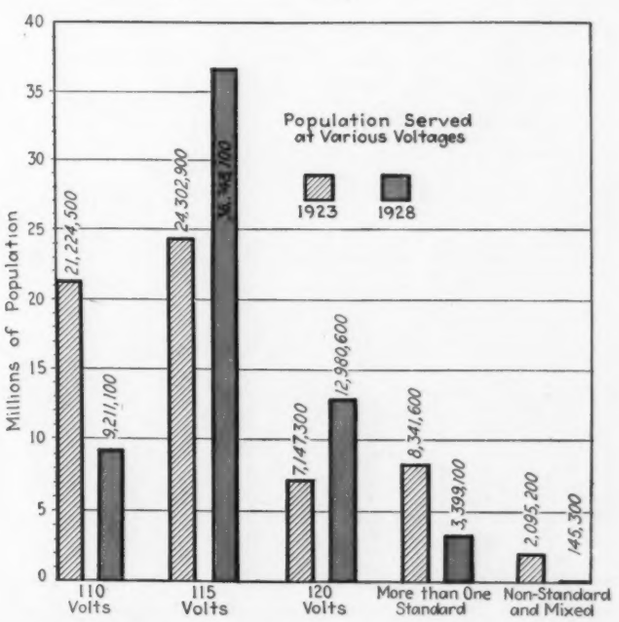
The number of communities now listed exceeds that in the survey of 1923 by more than 4,000. The actual number of new ones is somewhat greater than that because of the dropping of some on which no information was obtainable. The change is obviously confined to very small communities; the population accounted for is substantially the same as before.

The statement of total population served, 63,111,500, is probably conservative, for three reasons: (a) There has been a very considerable increase in population, particularly in our larger cities, since the 1920 census, on which it is based; (b) it is almost impossible to avoid omitting the population, often considerable, just outside the corporate limits of cities except by estimating; (c) no provision can be made in such a survey for the purely agricultural population represented by the 300,000 to 350,000 farm customers.



Population of Communities on which Analysis is Based and Per Cent of Population Served at Various Voltages





Service at 115 volts now predominates

More Than Seasonal Gain in Middle Atlantic States Industrial Activity

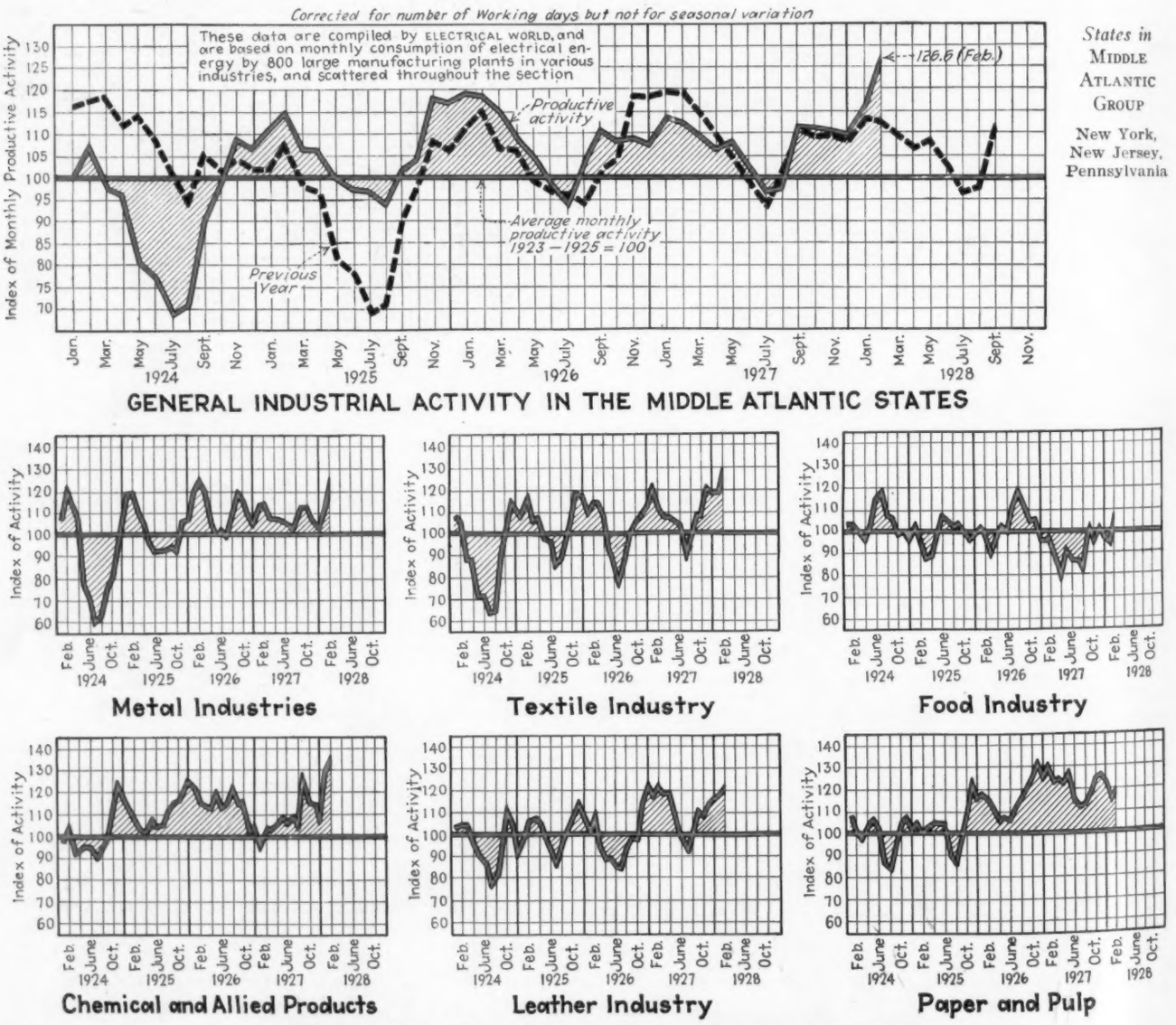
MANUFACTURING plants in the Middle Atlantic States witnessed a slightly more than normal seasonal increase in activities during February, and the productive activities of these plants were also about 12.5 per cent over those of February, 1927. It appears that industrial conditions in this section during February were slightly better than those characterizing industry in the nation as a whole.

During February five of the section's primary industries—chemicals and allied products, ferrous and non-ferrous metal working plants, rolling mills and steel plants, paper and pulp, and textiles—witnessed productive activities materially over those reported for February, 1927. On the other hand, both the leather and its products industry and the paper and pulp industry were operating slightly below February, 1927. It now seems probable that the volume of industrial production during the first quarter of the current year was between 7 and 10 per cent over that reported for the same period last year.

Indexes of Productive Activity in the Middle Atlantic States
All Figures Adjusted for Number of Working Days

	Feb., 1928	Jan., 1928	Dec., 1927	Average Full Year, 1927
All industries	126.6	116.2	109.9	107.5
Chemical and allied products	134.0	129.0	107.3	108.4
Food and kindred products	103.0	93.0	97.0	.....
Leather and its products	122.0	119.0	115.0	101.9
Lumber and its products	114.0	102.6	104.5	.....
Metals group	122.6	112.4	101.4	107.7
Rolling mills and steel plants	120.8	110.5	101.5	.....
Metal fabricating plants (ferrous and non-ferrous)	124.4	114.4	101.4	105.6
Paper and pulp	118.7	113.4	123.5	122.6
Stone, clay and glass	116.9	103.9	97.6	.....
Textiles	130.2	119.8	120.0	108.4

ELECTRICAL WORLD *Barometer of Industrial Activity in the Middle Atlantic States*


Corrected for number of Working days but not for seasonal variation
These data are compiled by ELECTRICAL WORLD, and are based on monthly consumption of electrical energy by 800 large manufacturing plants in various industries, and scattered throughout the section
Index of Monthly Productive Activity
126.6 (Feb.)
Productive activity
Average monthly productive activity 1923—1925 = 100
Previous Year
States in MIDDLE ATLANTIC GROUP
New York, New Jersey, Pennsylvania
GENERAL INDUSTRIAL ACTIVITY IN THE MIDDLE ATLANTIC STATES
Index of Activity
Metal Industries
Textile Industry
Food Industry
Chemical and Allied Products
Leather Industry
Paper and Pulp
PRODUCTIVE ACTIVITY IN THE PRIMARY INDUSTRIES OF THE MIDDLE ATLANTIC STATES